THE FOUR STEPS TO CREATE A CLASSROOM WHERE STUDENTS ARE EXCITED TO LEARN MATHEMATICS

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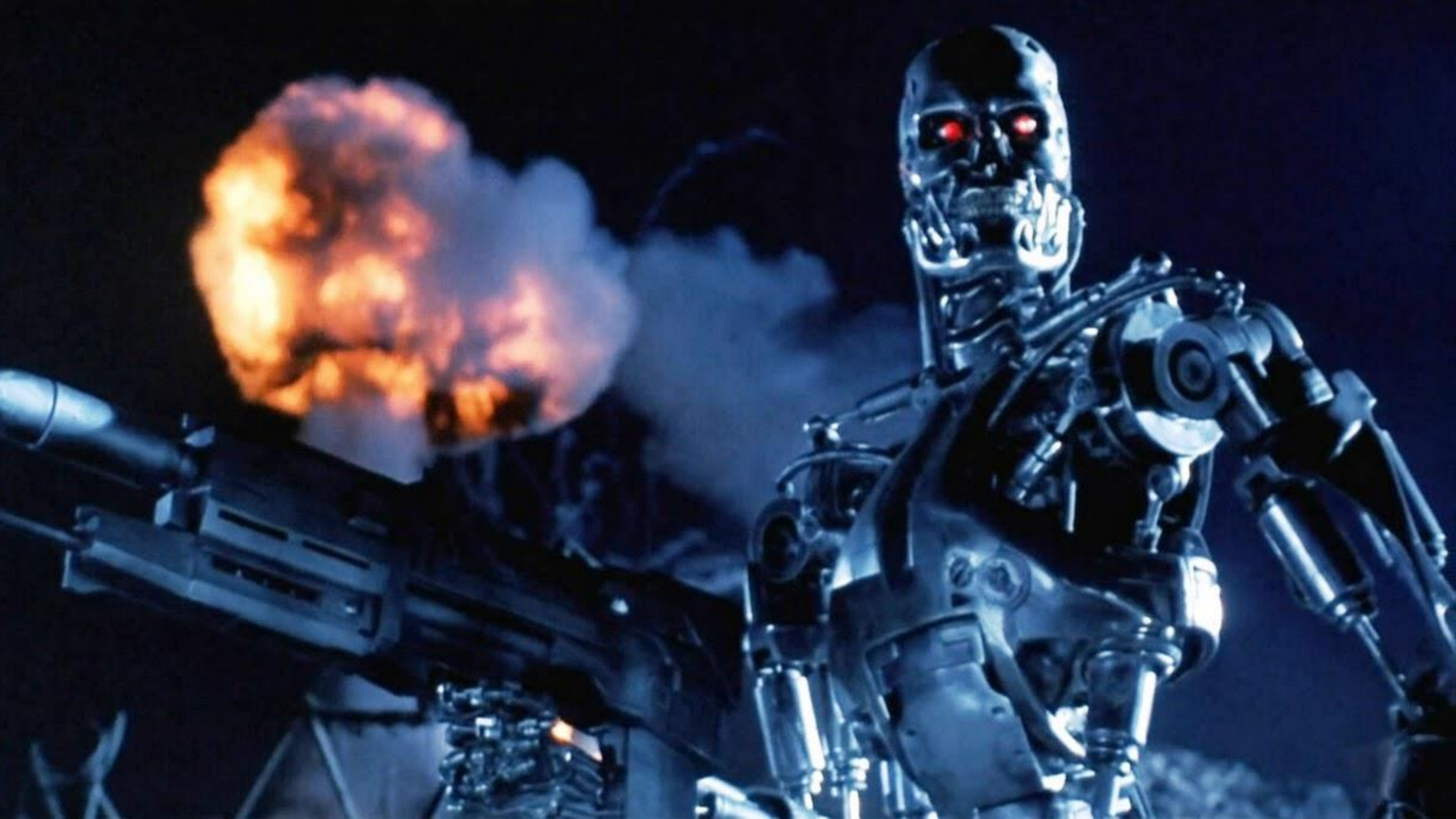
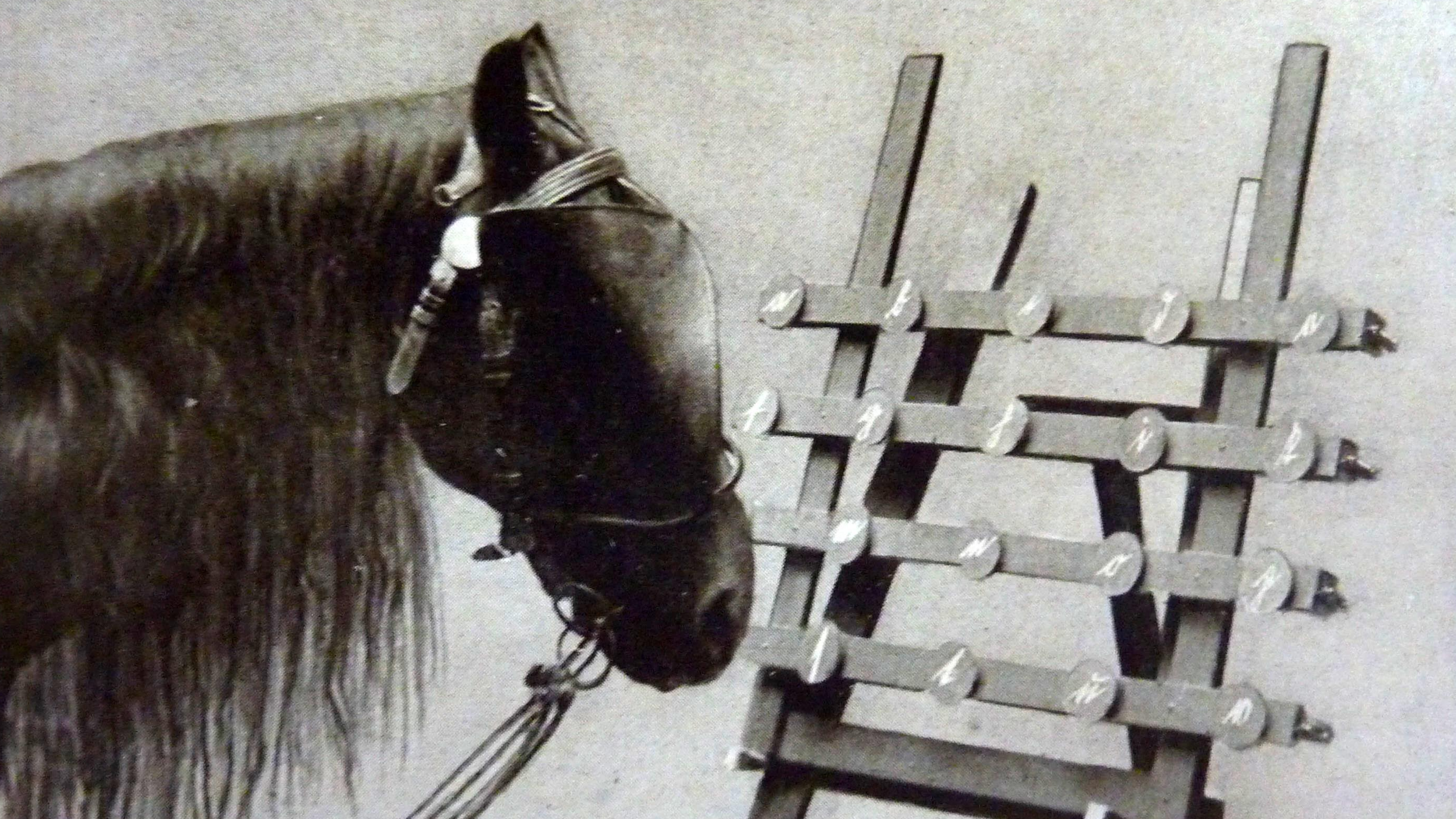
paradigm shift

GOALS

- ❑ CORRECT ANSWERS = UNDERSTANDING?
- ❑ MAKE OUR LESSONS UNFORGETTABLE
- ❑ RECONSIDER USING WORD PROBLEMS
- ❑ MAKE MATH CHALLENGING + ACCESSIBLE



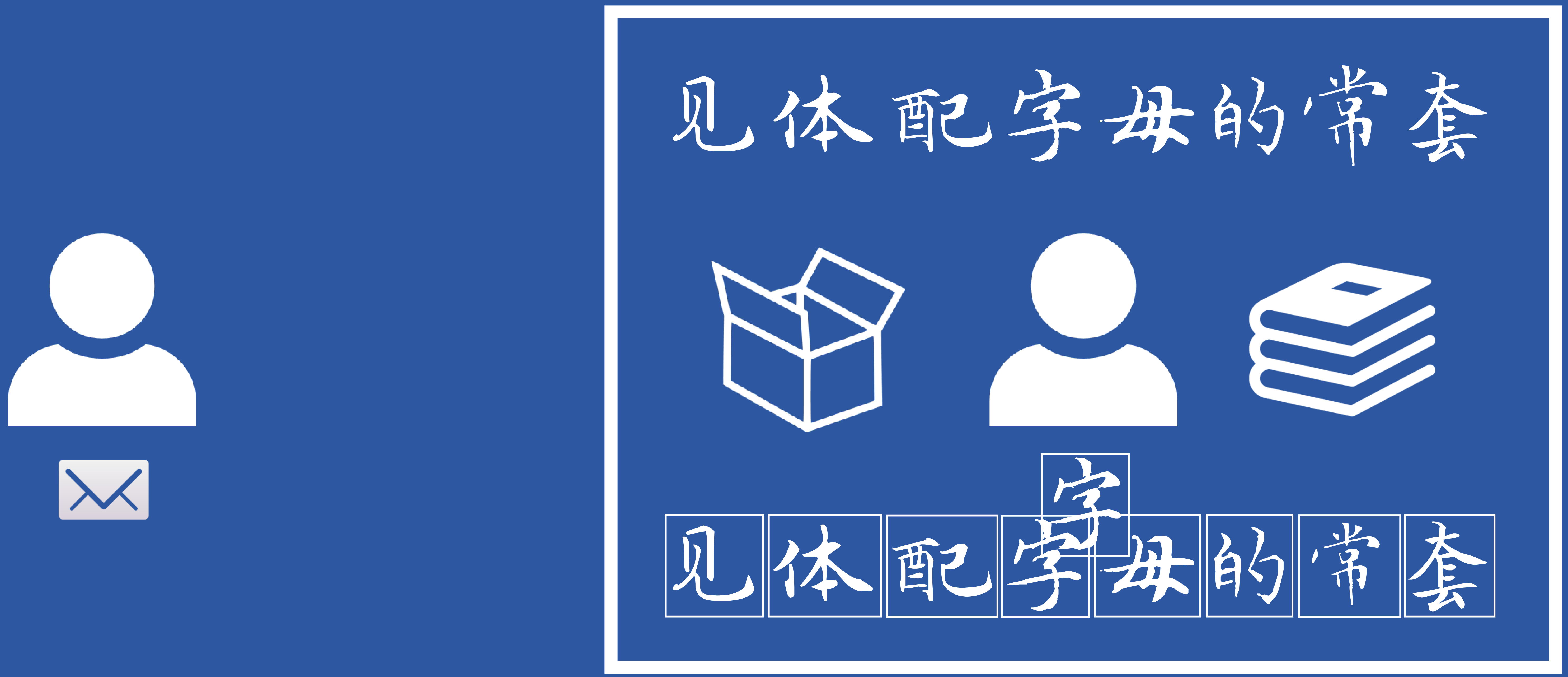

2/3 + 3/4 =
26743 : 8 =
112986 x 3 =



Yes… no… uh…
yes… maybe?

MANY STUDENTS

CHINESE ROOM



DISCUSSION TIME

- How is it possible for students to get correct answers yet not understand what they did?
- How can we tell if the problems we use are Chinese room and horse proof?

GOALS

- ☑ CORRECT ANSWERS = UNDERSTANDING?
- ☐ MAKE OUR LESSONS UNFORGETTABLE
- ☐ RECONSIDER USING WORD PROBLEMS
- ☐ MAKE MATH CHALLENGING + ACCESSIBLE

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Robert Home

February 28 ·

If a theif forces you to take money out of an ATM, do not argue or resist. What you do is punch in your pin # backwards. EX: if its 1234, you'll type 4321. When you do that, the money will come out but will be stuck in the slot. The machine will immediately alert the local police without the robbers knowledge & begin taking photos of the suspect.
Every ATM has the feature. Stay safe.

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1,782 shares

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Will Entering Your PIN in Reverse at an ATM Summon the Police?

Entering your PIN in reverse at any ATM will not automatically send an alarm to local police -- the idea is nothing more than an old and unimplemented suggestion.

CLAIM

Entering your PIN in reverse at any ATM will automatically summon the police.
See Example(s)

RATING

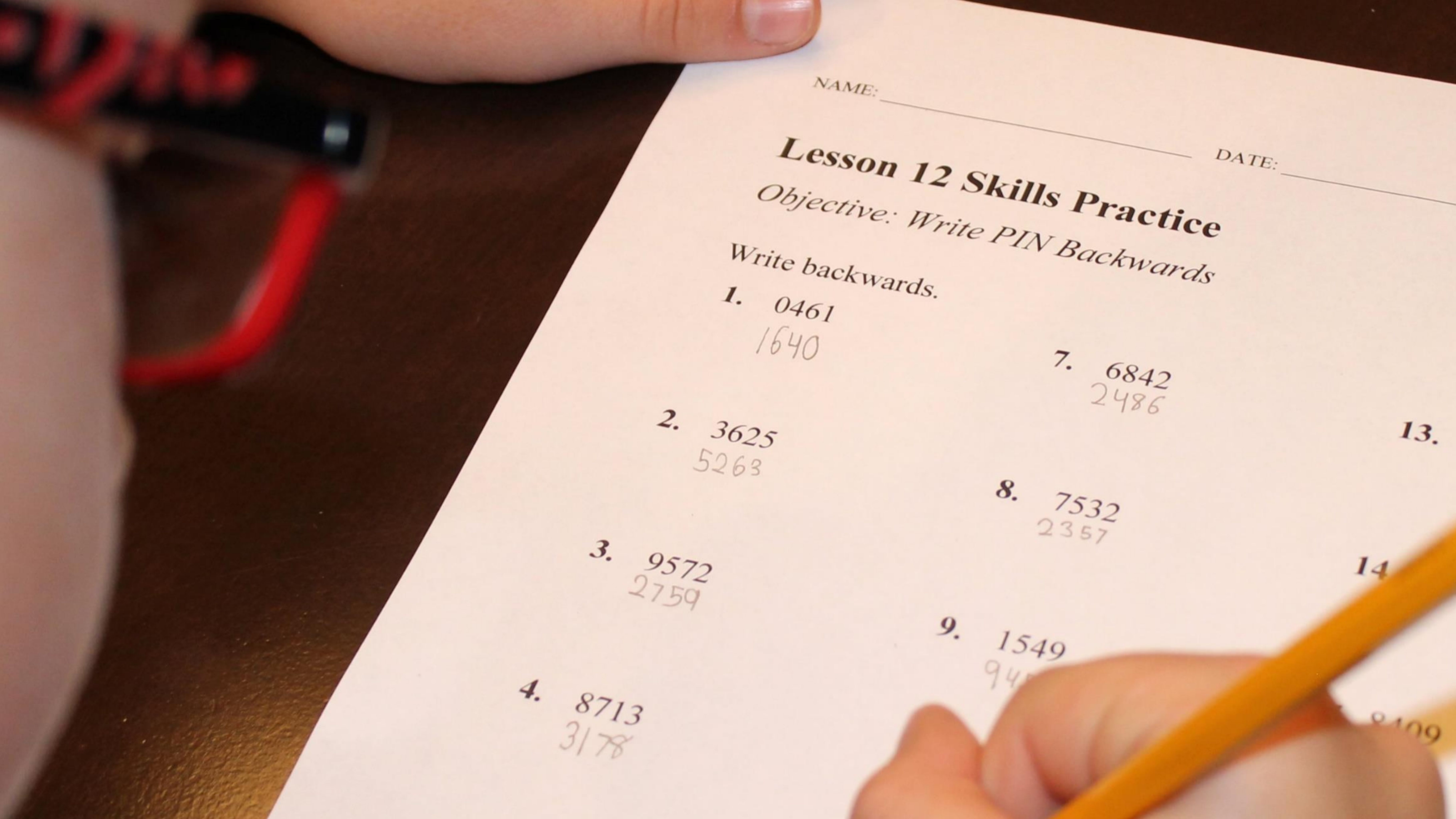
FALSE

ORIGIN

Messages offering a seemingly helpful heads-up about how to deal with a situation in which one is forced to hand over money withdrawn from an ATM under duress began circulating on the Internet in September 2006:

Tell them what you're going to tell them. Tell it to them. Then tell them what you told them.

UNKNOWN



NAME:

DATE:

Lesson 12 Skills Practice

Objective: Write PIN Backwards

Write backwards.

1. 0461
   1640

2. 3625
   5263

3. 9572
   2759

4. 8713
   3178

7. 6842
   2486

8. 7532
   2357

9. 1549

13.

Presentation	Lesson
• Tell them what you're going to tell them.	• State the lesson objectives.
• Tell it to them.	• Teach the lesson.
• Then tell them what you told them.	• Review the lesson objectives.

The definition of insanity is doing the same thing over and over again but expecting different results.

UNKNOWN

Why Some Ideas Survive and Others Die...

MADE to STICK

Chip Heath & Dan Heath

- Understood
- Remembered
- Lasting impact

STICKY ATTRIBUTES

- ❑ SIMPLE
- ❑ UNEXPECTED
- ❑ CONCRETE
- ❑ CREDIBLE
- ❑ EMOTIONAL
- ❑ STORIES

Simplify.

$$(x^2 + 3)(2x^3 - 7x + 4)$$

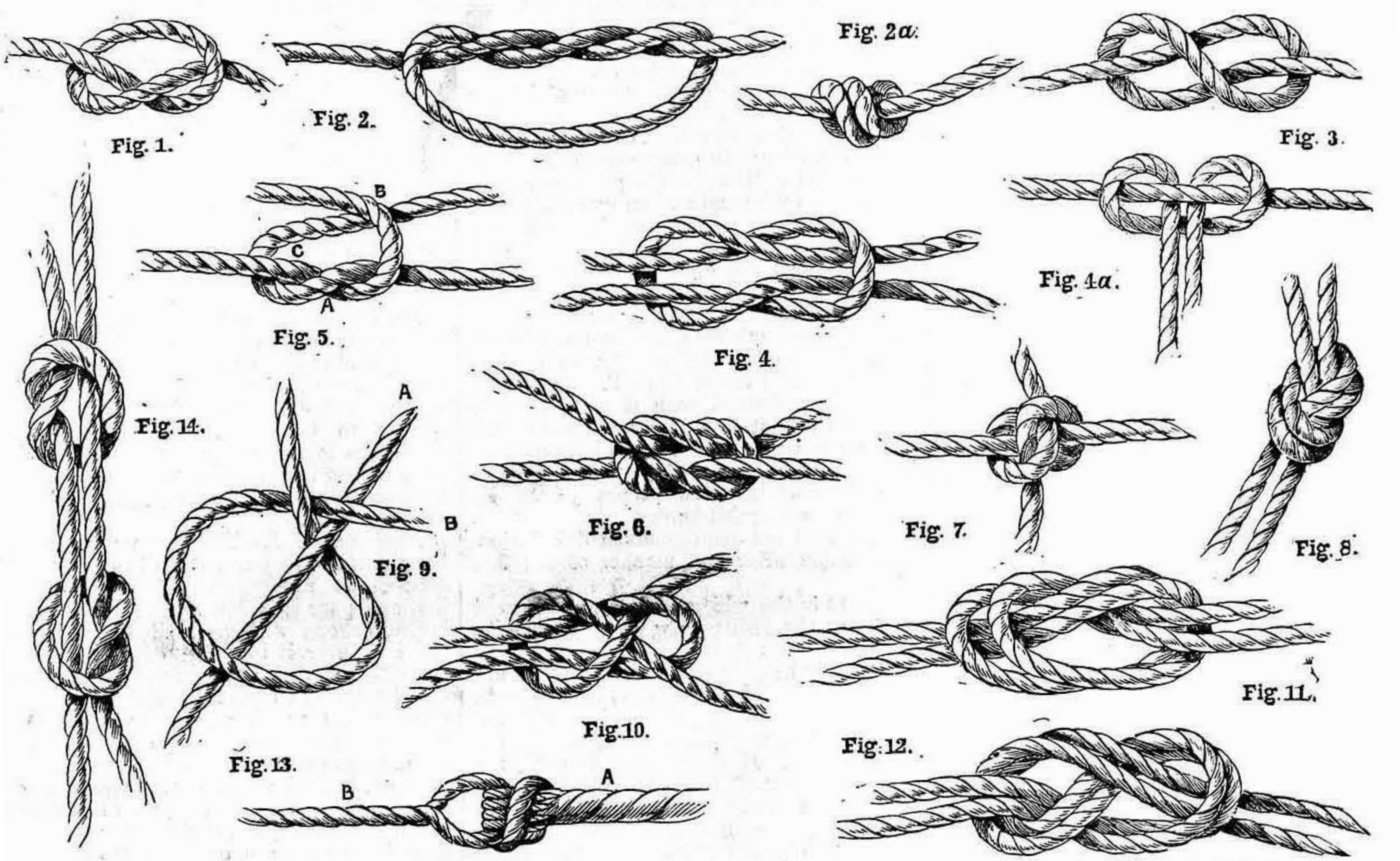
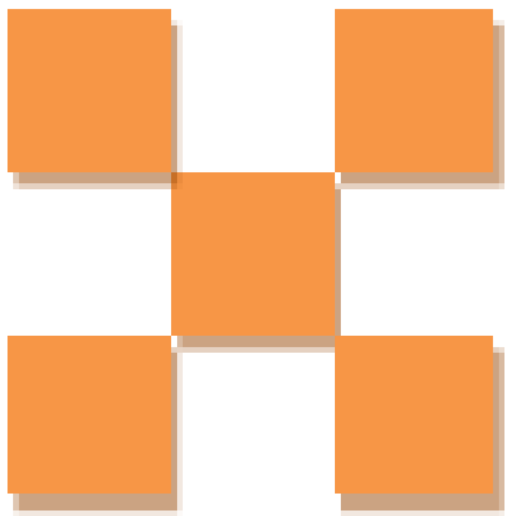


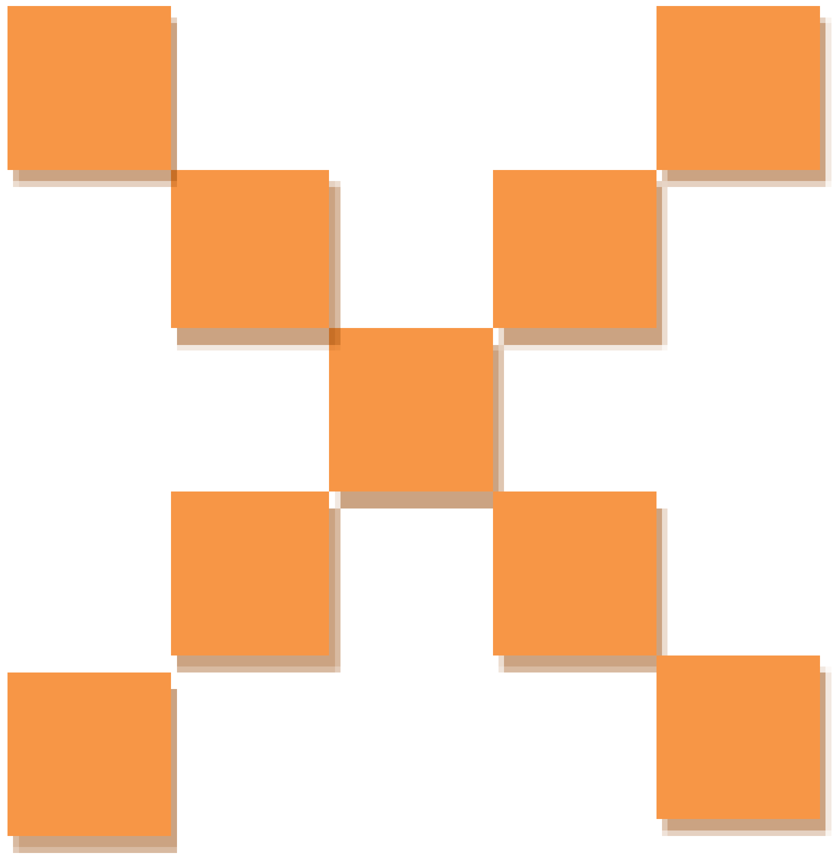
Fig. 1.
Fig. 2.
Fig. 2a.
Fig. 3.
B
C
A
Fig. 5.
Fig. 4.
Fig. 4a.
Fig. 14.
A
B
Fig. 9.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 10.
Fig. 11.
Fig. 13.
B
A
Fig. 12.

If math is the aspirin, then how do you create the headache?

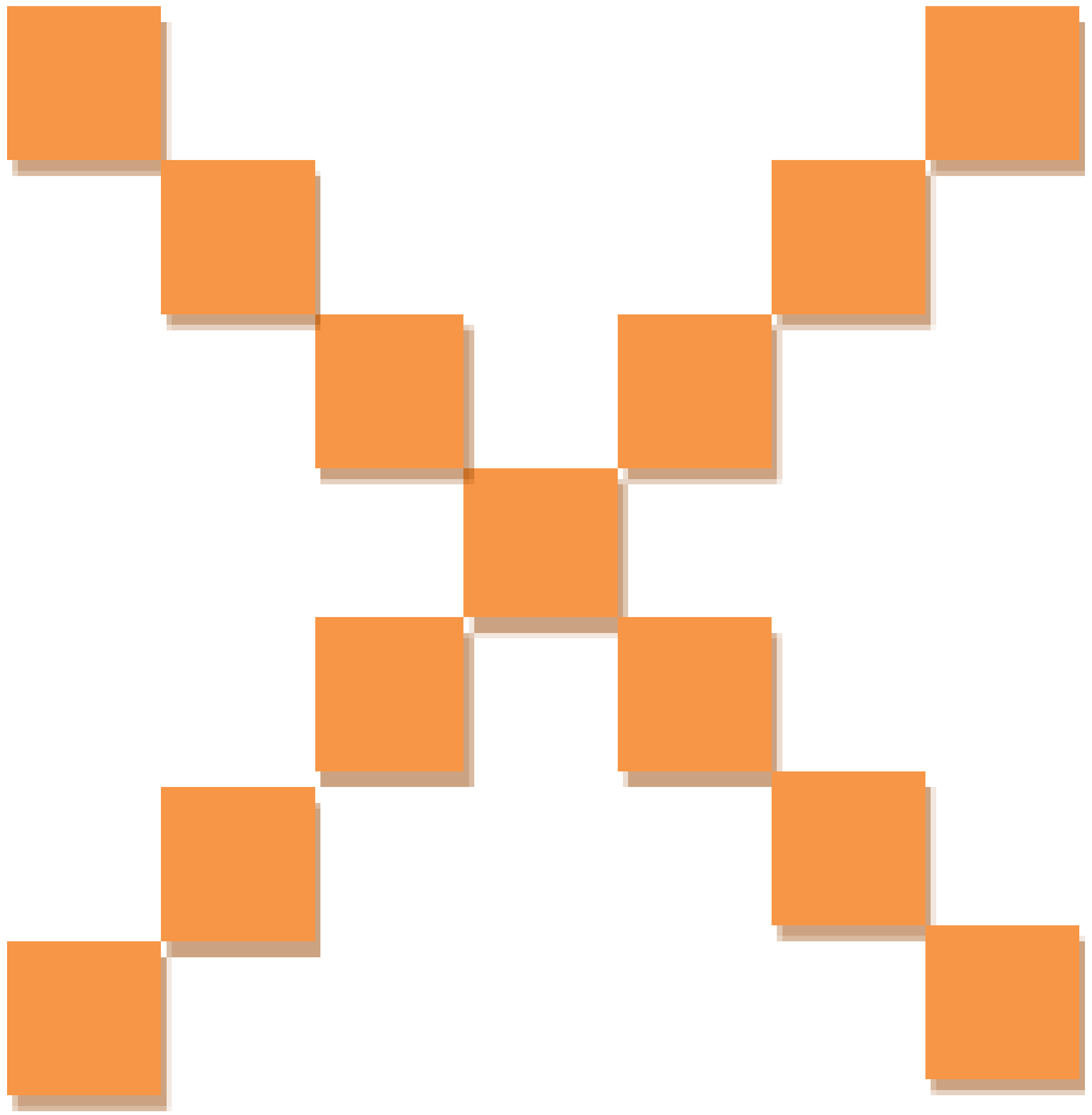
DAN MEYER



Step 1

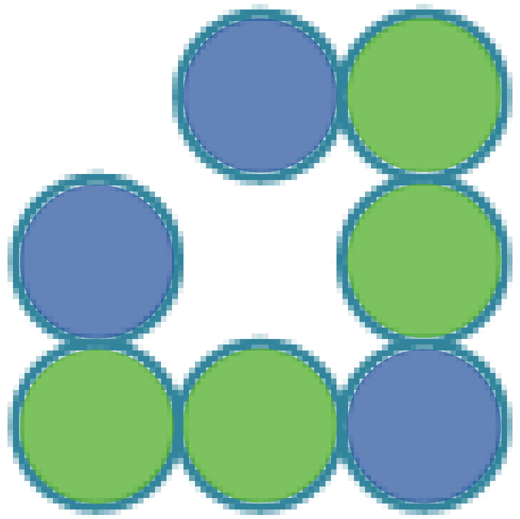


Step 2

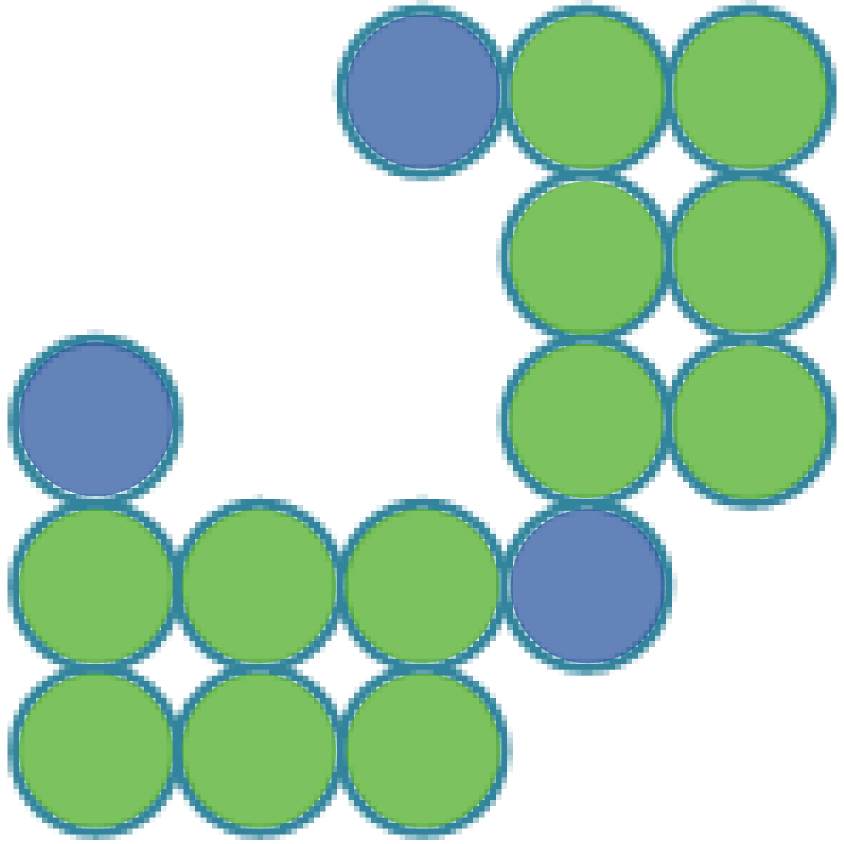


Step 3

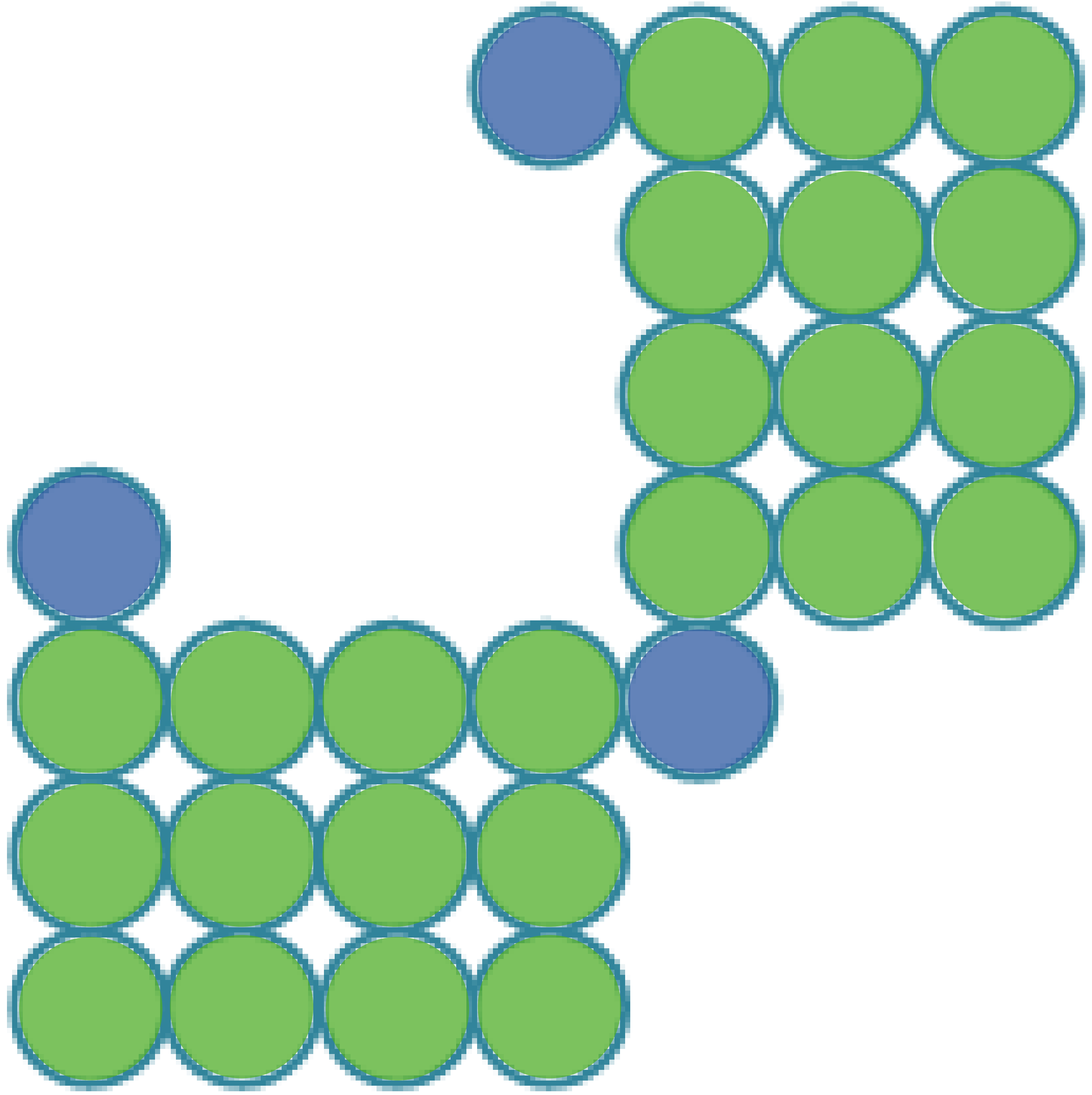
Source: visualpatterns.org



Step 1

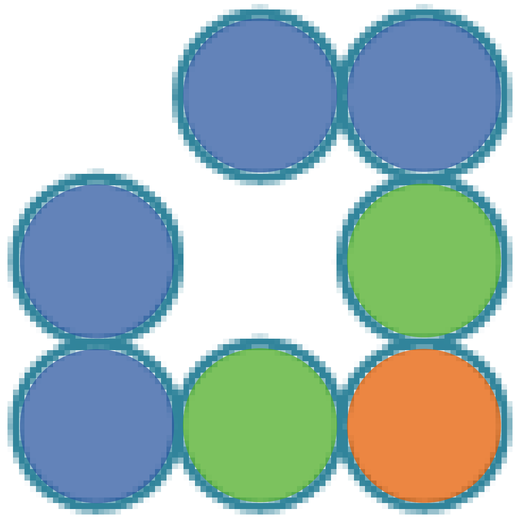


Step 2



Step 3

Source: visualpatterns.org



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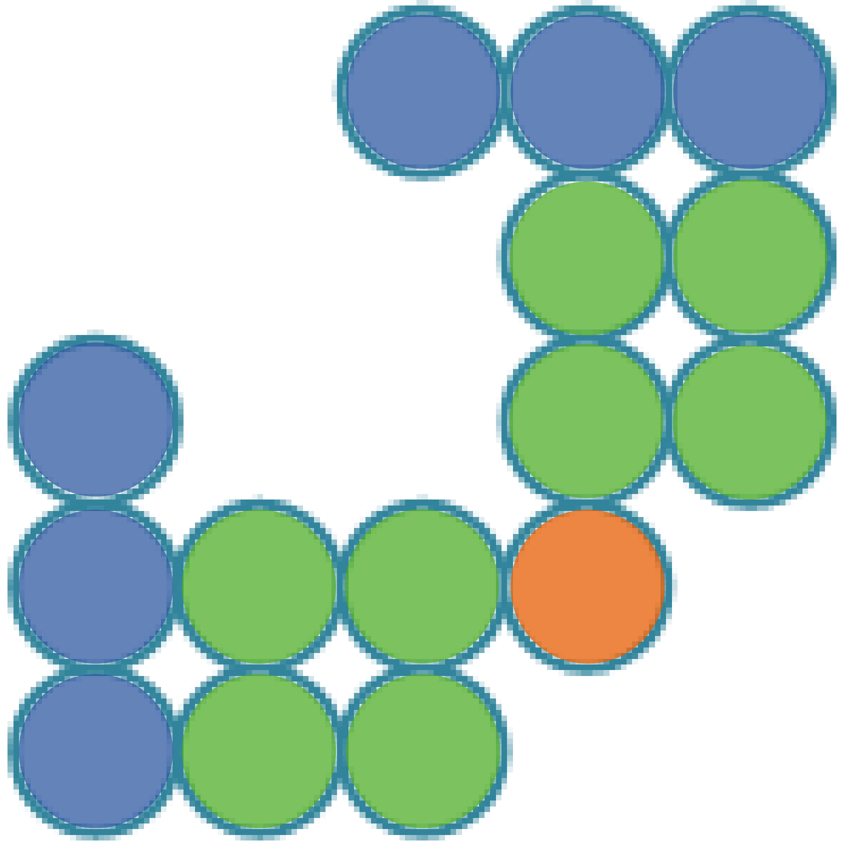
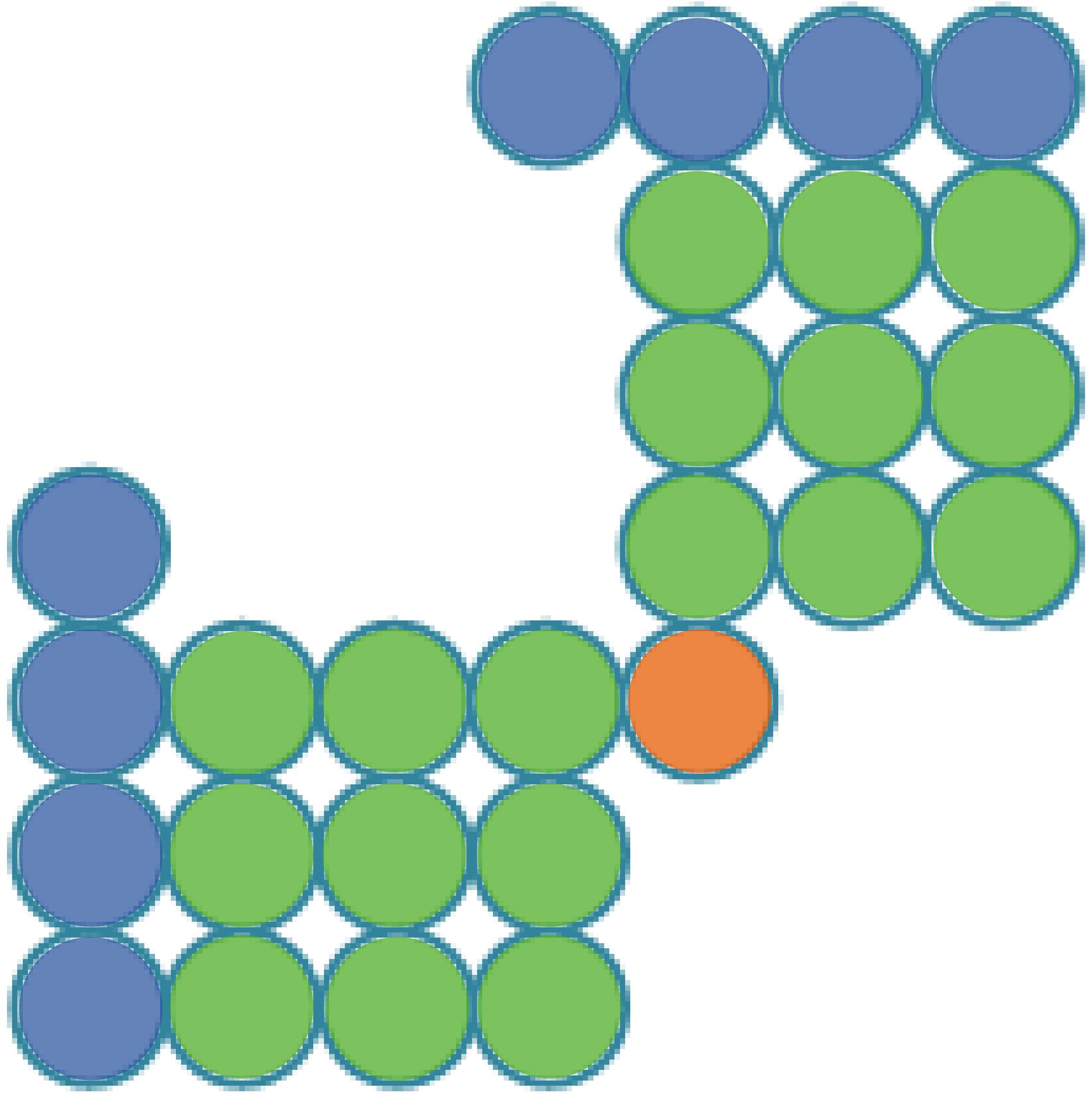


Step 2



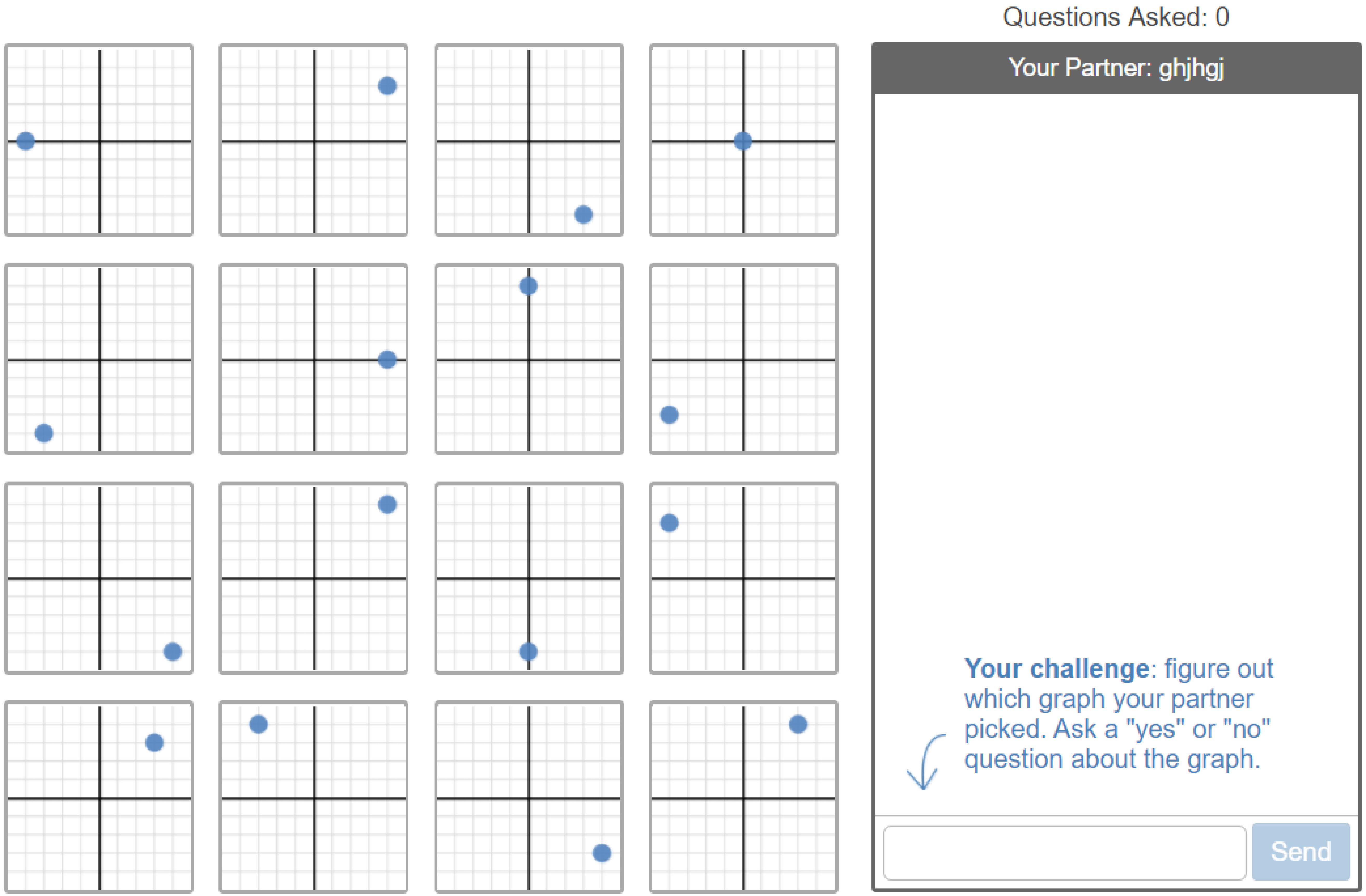
Step 3

Source: visualpatterns.org

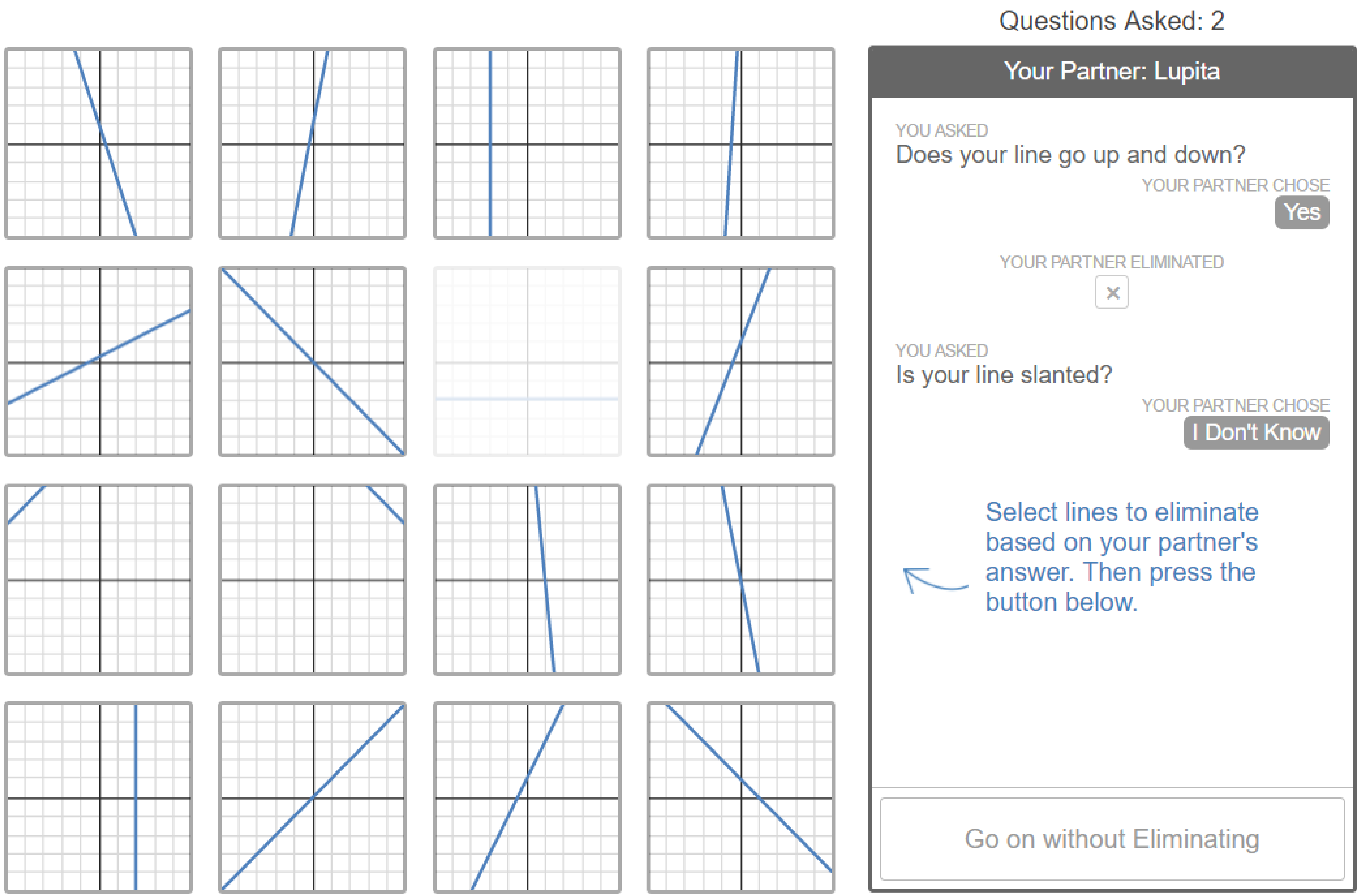
Select a person that's special to you for any reason. Next

Skip the practice round.

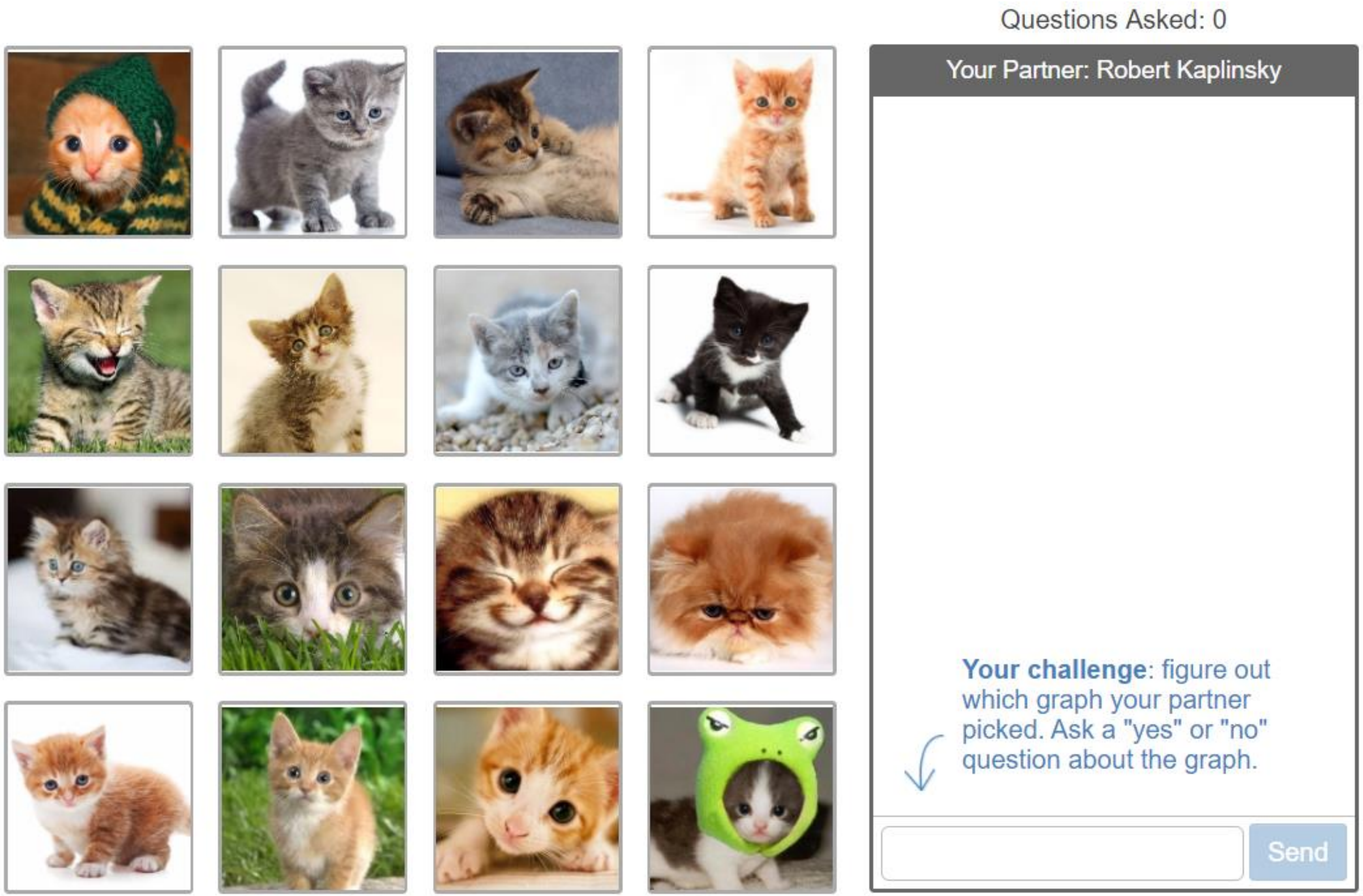
Source: teacher.desmos.com/polygraph



Source: teacher.desmos.com/polygraph

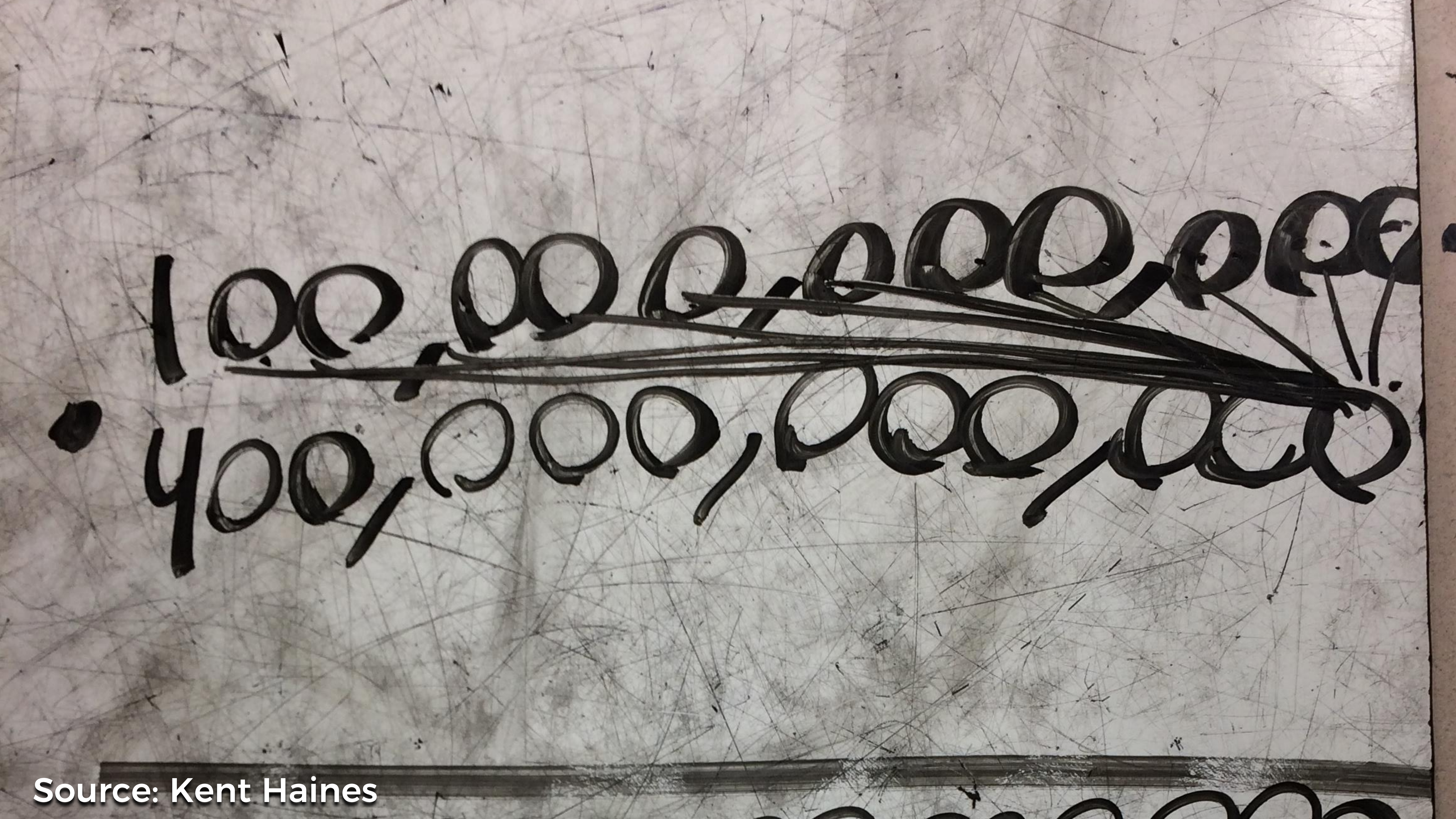


Source: teacher.desmos.com/polygraph



Source: teacher.desmos.com/polygraph

Source: robertkaplinsky.com/lessons



Source: Kent Haines

Source: robertkaplinsky.com/lessons

STICKY ATTRIBUTES

- [x] SIMPLE
- [ ] UNEXPECTED
- [ ] CONCRETE
- [ ] CREDIBLE
- [ ] EMOTIONAL
- [ ] STORIES

Source: reasonandwonder.com

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Source: reasonandwonder.com

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THINKING TIME

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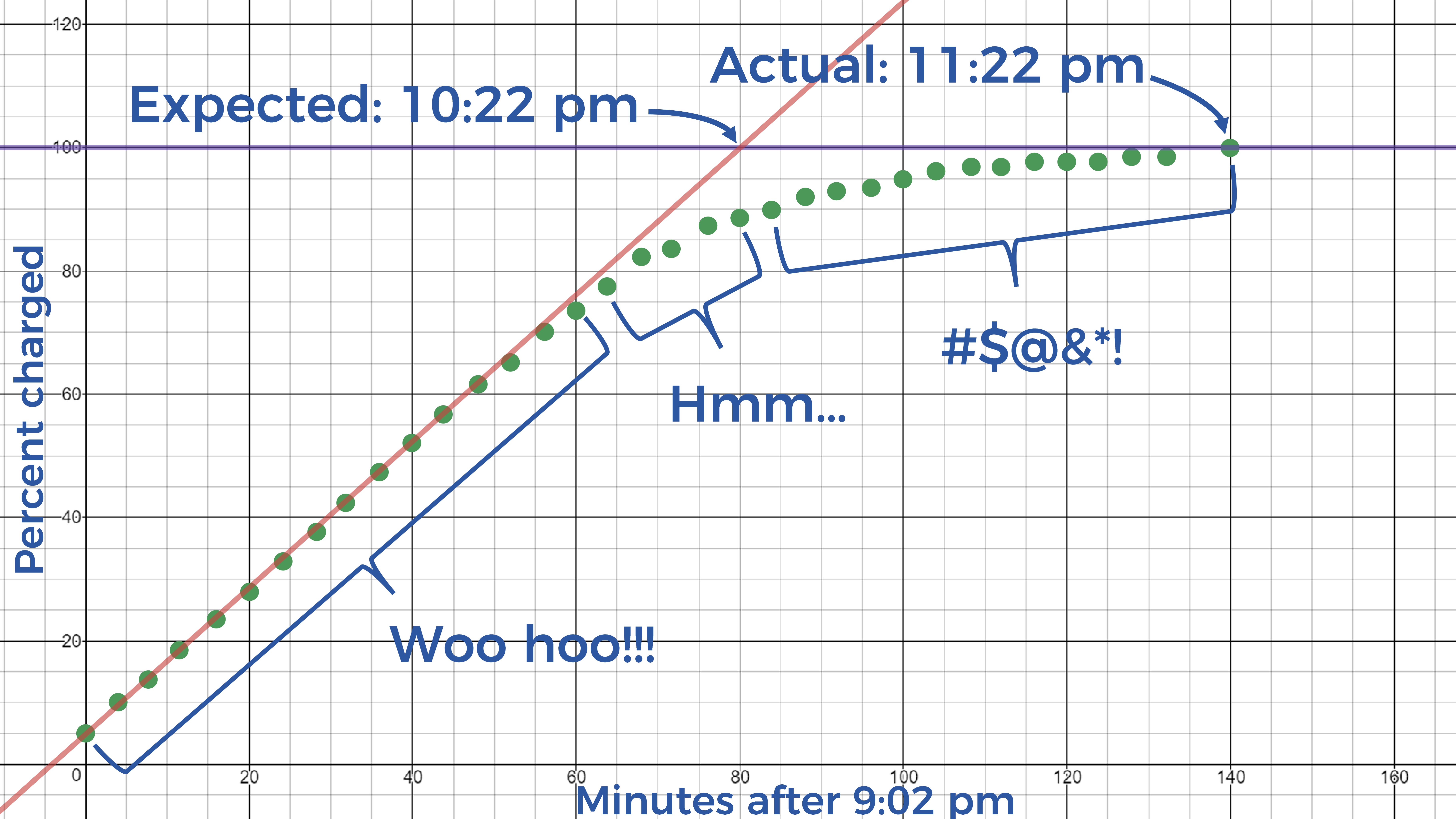
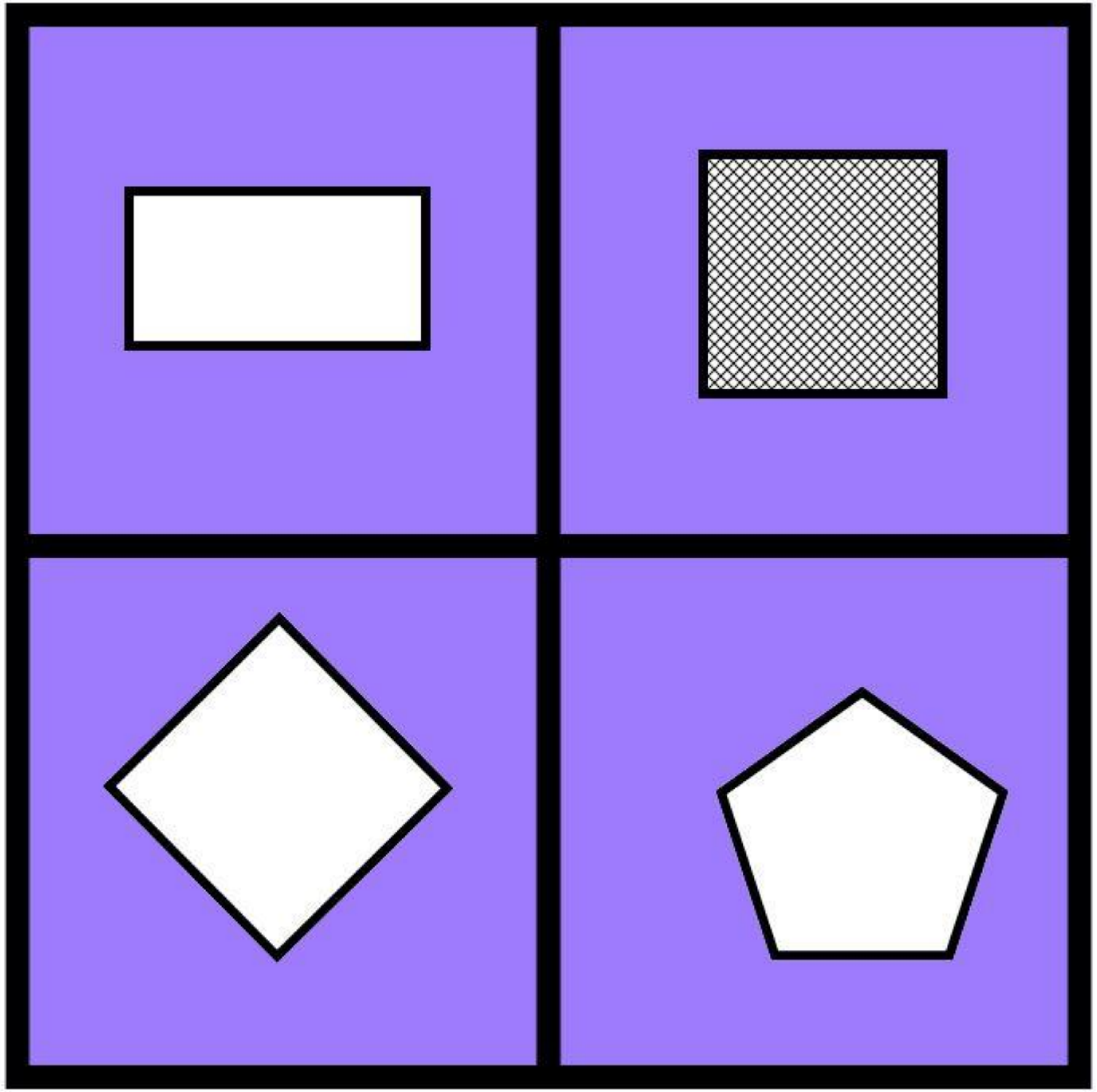
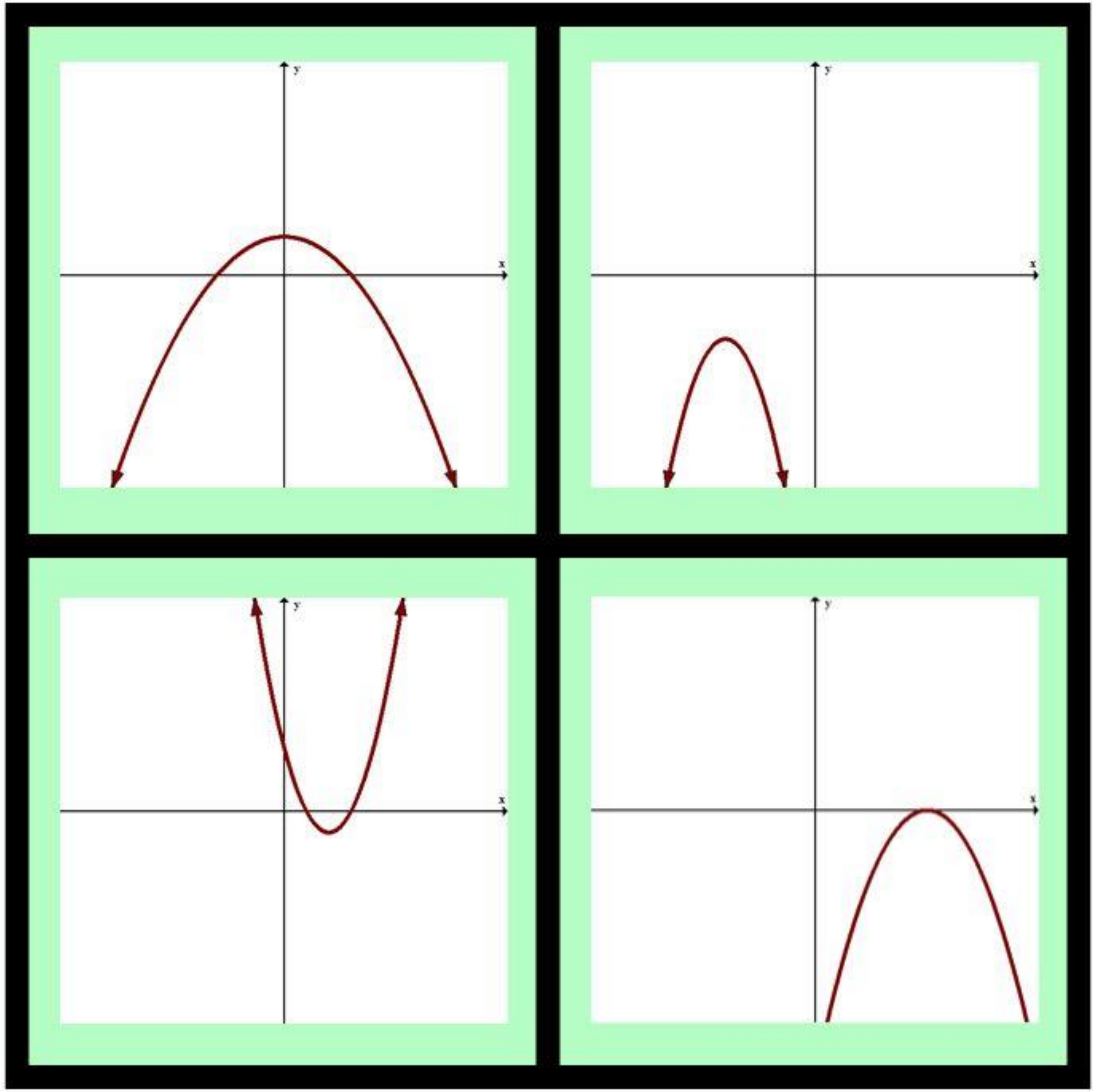

Expected: 10:22 pm
Actual: 11:22 pm
Woo hoo!!!
Hmm...
#$@&*!
Percent charged
Minutes after 9:02 pm
0
20
40
60
80
100
120
140
160

UNEXPECTED

- ❏ PATTERN BREAKING
- ❏ COUNTERINTUITIVE
- ❏ KNOWLEDGE GAPS
- ❏ OPEN MIDDLE



Source: wodb.ca



y
x
y
x
y
x
y
x

UNEXPECTED

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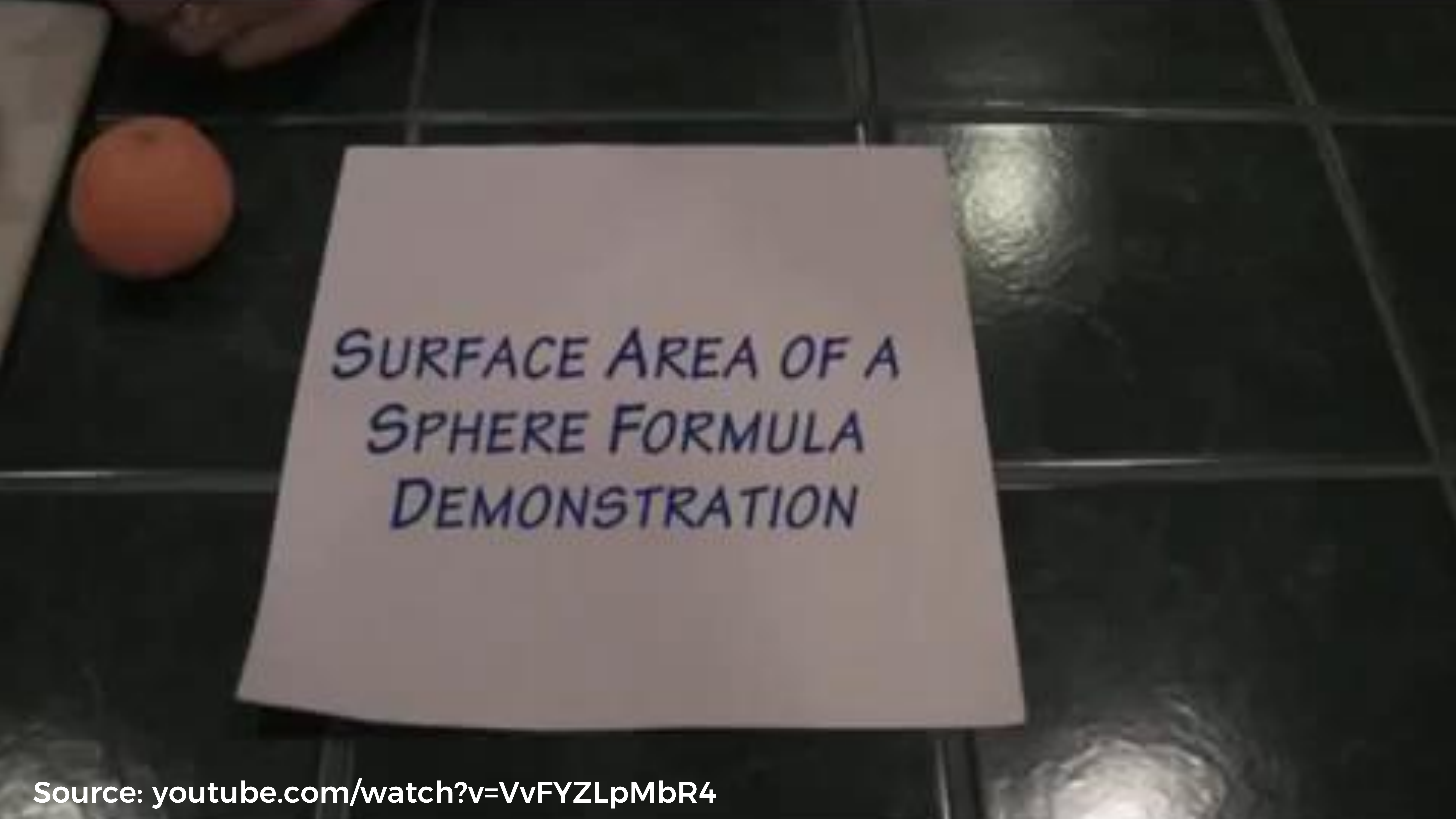
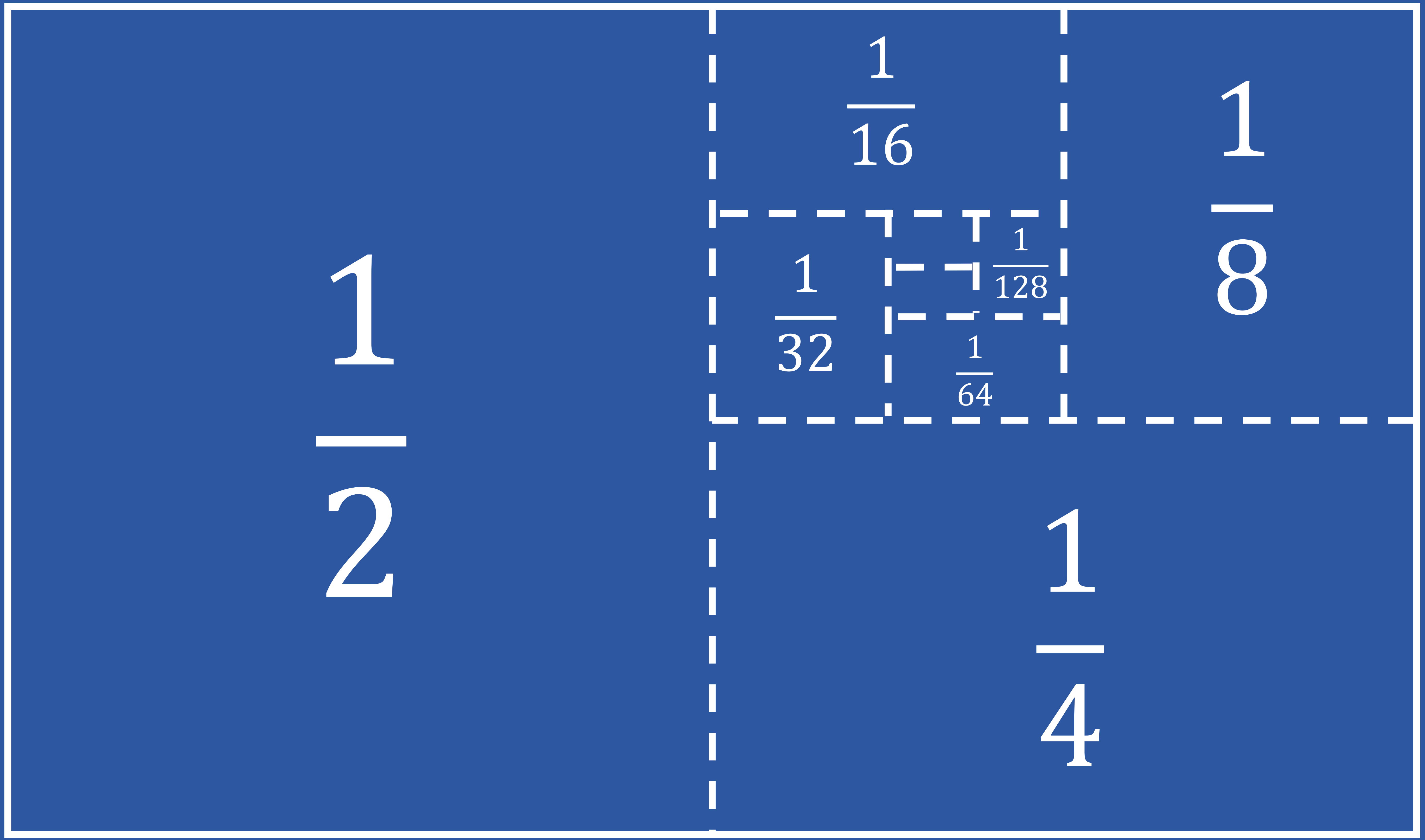


Source: youtube.com/watch?v=VvFYZLpMbR4

$$\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\frac{1}{32}+\cdots$$

$$\approx 1$$



$\frac{1}{2}$
$\frac{1}{16}$
$\frac{1}{8}$
$\frac{1}{32}$
$\frac{1}{128}$
$\frac{1}{64}$
$\frac{1}{4}$

Source: Kyle Pearce - youtube.com/watch?v=Yr53Ji4SZDg

UNEXPECTED

- [x] PATTERN BREAKING
- [x] COUNTERINTUITIVE
- [ ] KNOWLEDGE GAPS
- [ ] OPEN MIDDLE

Curiosity… arises from the perception of a gap in knowledge or understanding.

GEORGE LOEWENSTEIN

Source: robertkaplinsky.com/lessons

Source: robertkaplinsky.com/lessons

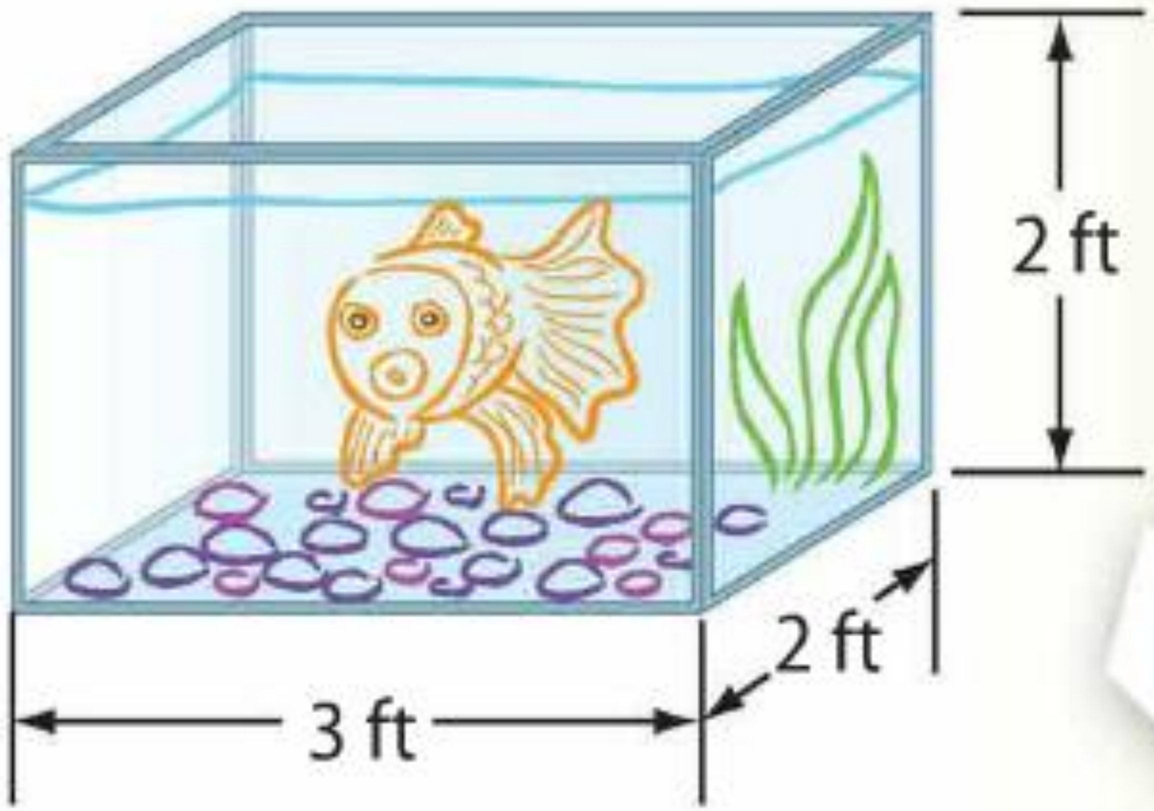
Source: robertkaplinsky.com/lessons

Source: robertkaplinsky.com/lessons

Real-World Link

Watch

Aquarium The dimensions of an aquarium are shown.



1. What is the area of the base of the aquarium? ______

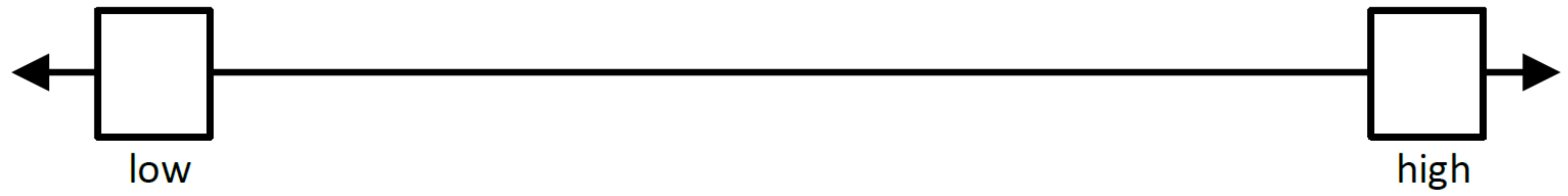
2. What is the height of the aquarium? ______

3. Fill in the blanks to find the volume.

______ $\times$ ______ $\times$ ______ $= 12 \text{ ft}^3$

What problem are you trying to figure out?

What estimates do you have?



Place your estimate on the number line.

What info do you already know about the problem?

What info do you need about the problem?

What is your conclusion? How did you reach that conclusion?

UNEXPECTED

- ☑ PATTERN BREAKING
- ☑ COUNTERINTUITIVE
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- ☐ OPEN MIDDLE


N

Google Maps My Village to Treasure Chest Travel 3621 miles, 21 days, 4 hours

Map data ©2017 Google 500 mi

My Village

	Treasure Map	Google Maps
Beginning	Closed	Closed
Middle	Open	Closed
End	Closed	Closed

Using the digits 1-9, at most one time each, fill in the boxes to create a fraction that is as close to one as possible.

$$\frac{\boxed{}\,\boxed{}}{\boxed{}\,\boxed{}}$$

Extension: How many ways can you prove that you are correct?

Source: Peter Morris on openmiddle.com

	Open Middle	Closed Middle
Beginning	Closed	Closed
Middle	Open	Closed
End	Closed	Closed

Name _______________ My Homework _______________

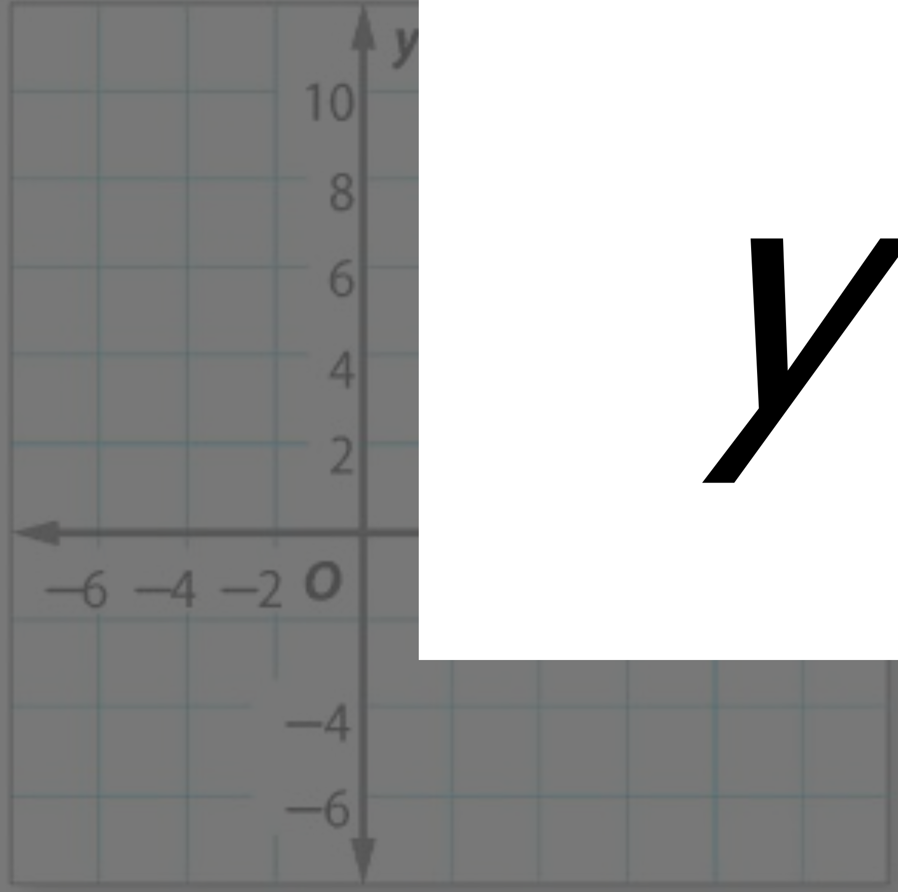
Independent Practice

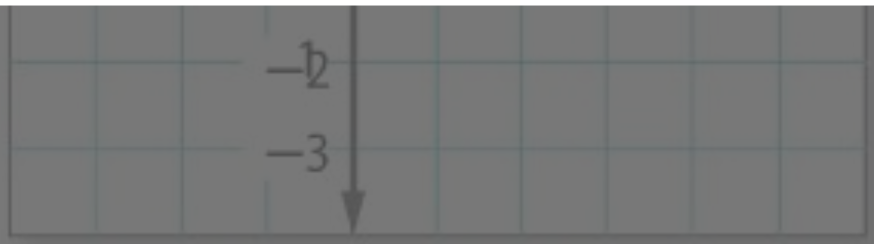
Solve each syst

1. $y = x$

$y = 2x - 4$

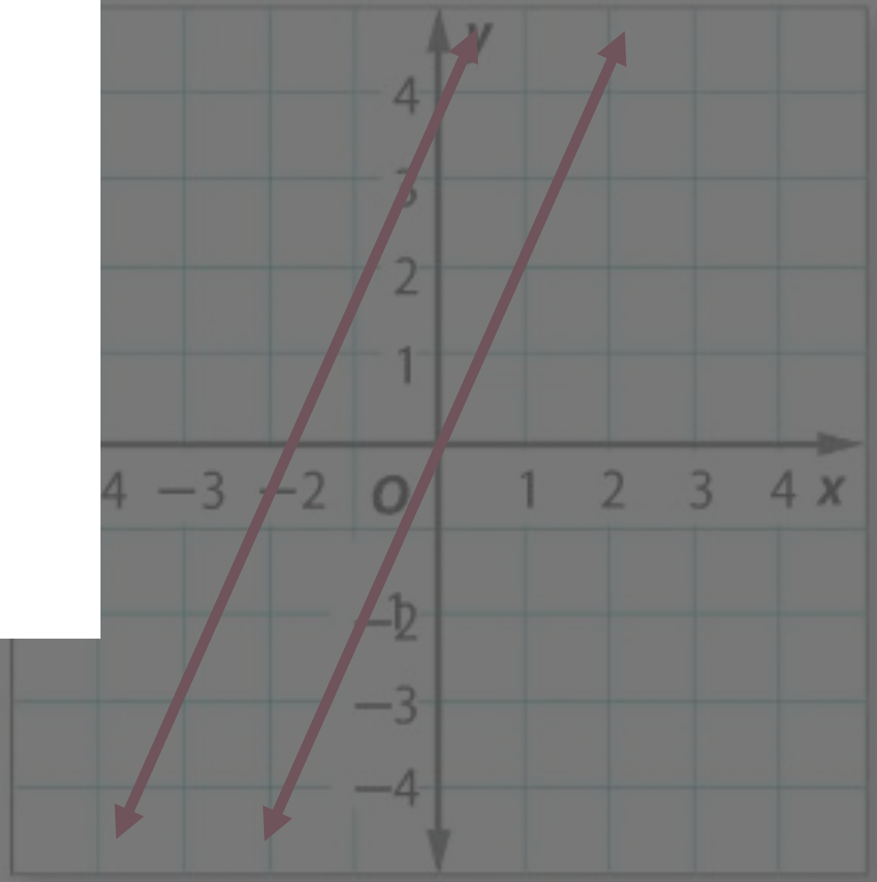
Show your work.





$y - 2x = 4$

$y = 2x$



$$0 \neq 4$$

$$y = 2x$$

UNEXPECTED

- ☑ PATTERN BREAKING
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- ☑ OPEN MIDDLE

STICKY ATTRIBUTES

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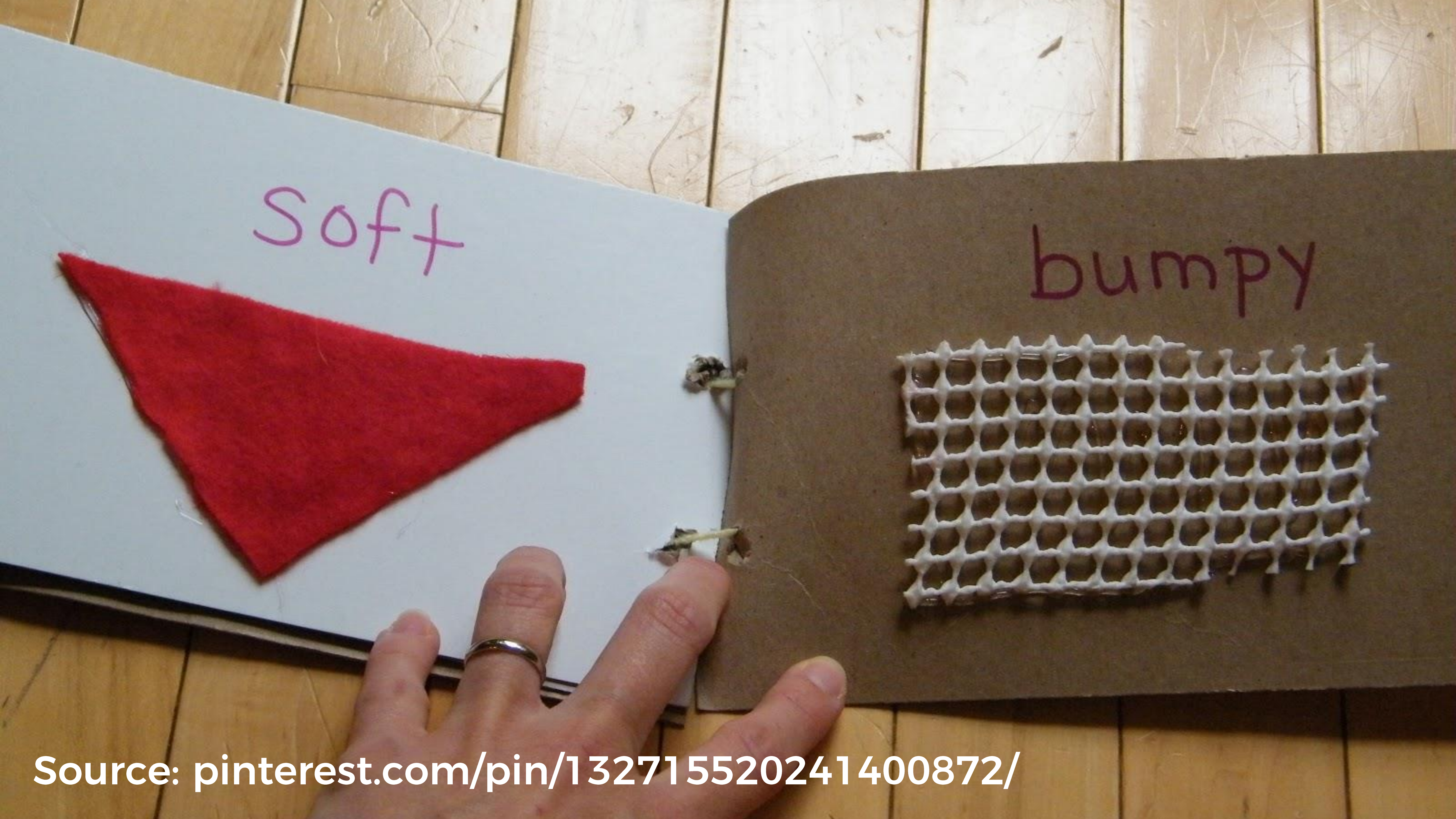


Source: pinterest.com/pin/132715520241400872/

Yellow
the fragrant
flowers,

Yellow the
stinky socks,

Source: Color Dog


HunterDouglas
HunterDouglas
WINDOW FASHIONS
VICTORIA
15553
PRESIDENT'S
MINI BRIE
19.6 OUNCES
5.99
4988
VALLEY SUN
SUN-DRIED TOMATOES
JULIENNE CUT 32 OUNCE
UNIT PRICE PER OUNCE
.234
SELL PRICE
7.49
PRESIDENT

NAME: ______________________________ DATE: ________________ PERIOD: ________

Lesson 7 Skills Practice

Objective: Divide Decimals by Decimals

Divide.

1. $4.86 \div 0.2$

7. $2.25 \div 0.15$

13. $7.52 \div 0.74$

2. $628.2 \div 34.9$

8. $421.6 \div 0.4$

14. $0.105 \div 0.6$


BOXING

Fans stream Nelly to help him pay off $2.4 million debt

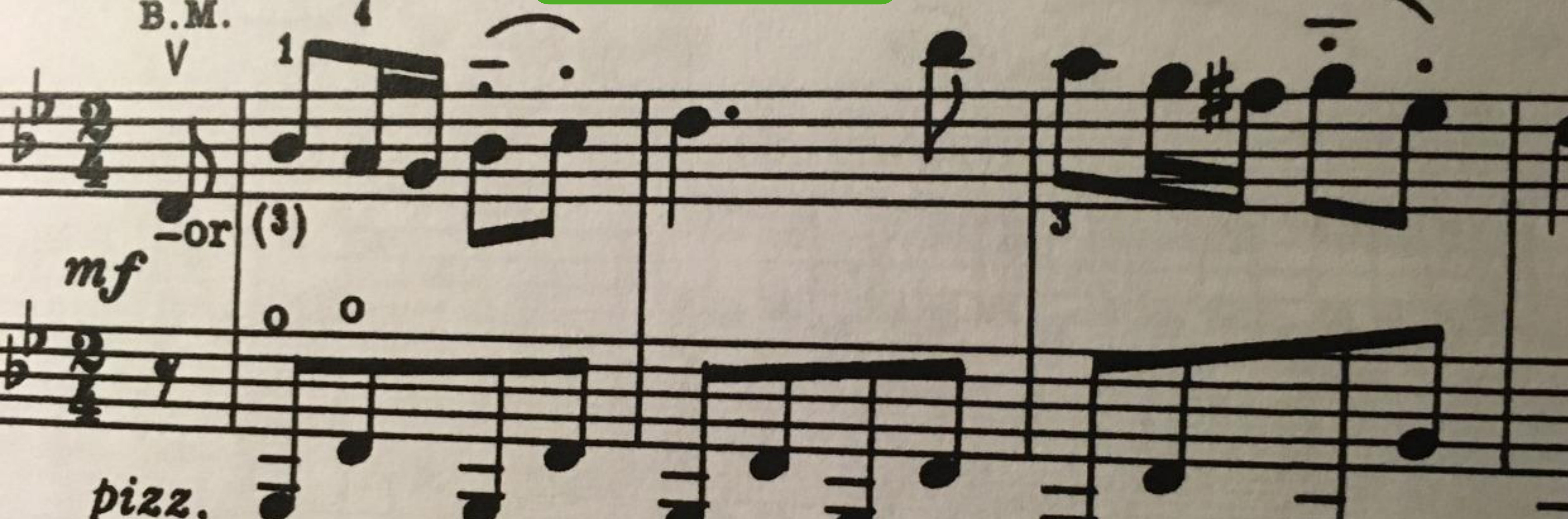
by Lisa Respers France @CNNMoney

September 13, 2016: 2:47 PM ET

- How many $0.006 are there in $2,400,000?
- How many 6 are there in 24?

9. Canzonett

In moderate time-with sparkle (Key of G minor)



LESSON 19-1

Stretching, Compressing, and Reflecting Sine and Cosine Graphs

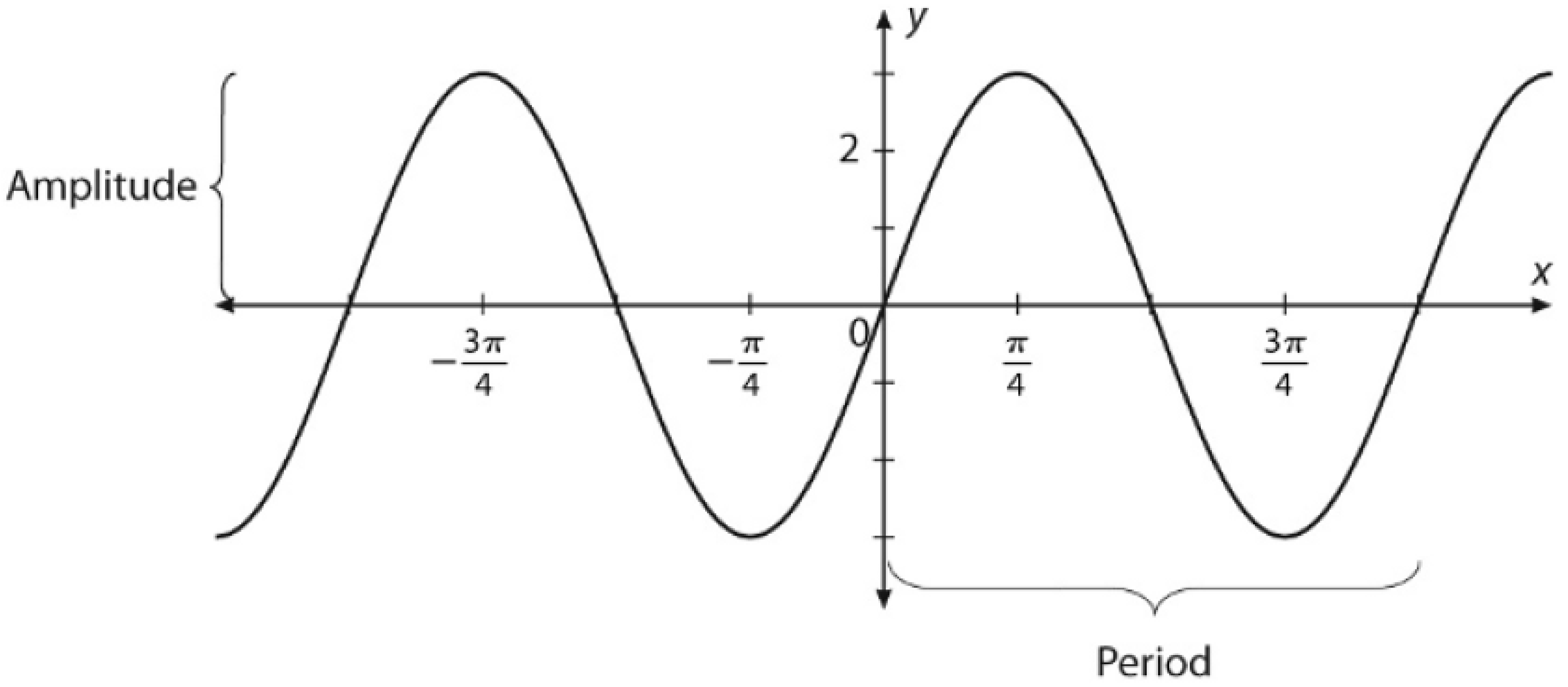
Reteach

For a sine function, $y = a\sin\left(\frac{1}{b}x\right)$.

Amplitude $= |a|$

Period $= 2\pi \bullet b$

If $a < 0$, the graph is reflected across the x-axis.

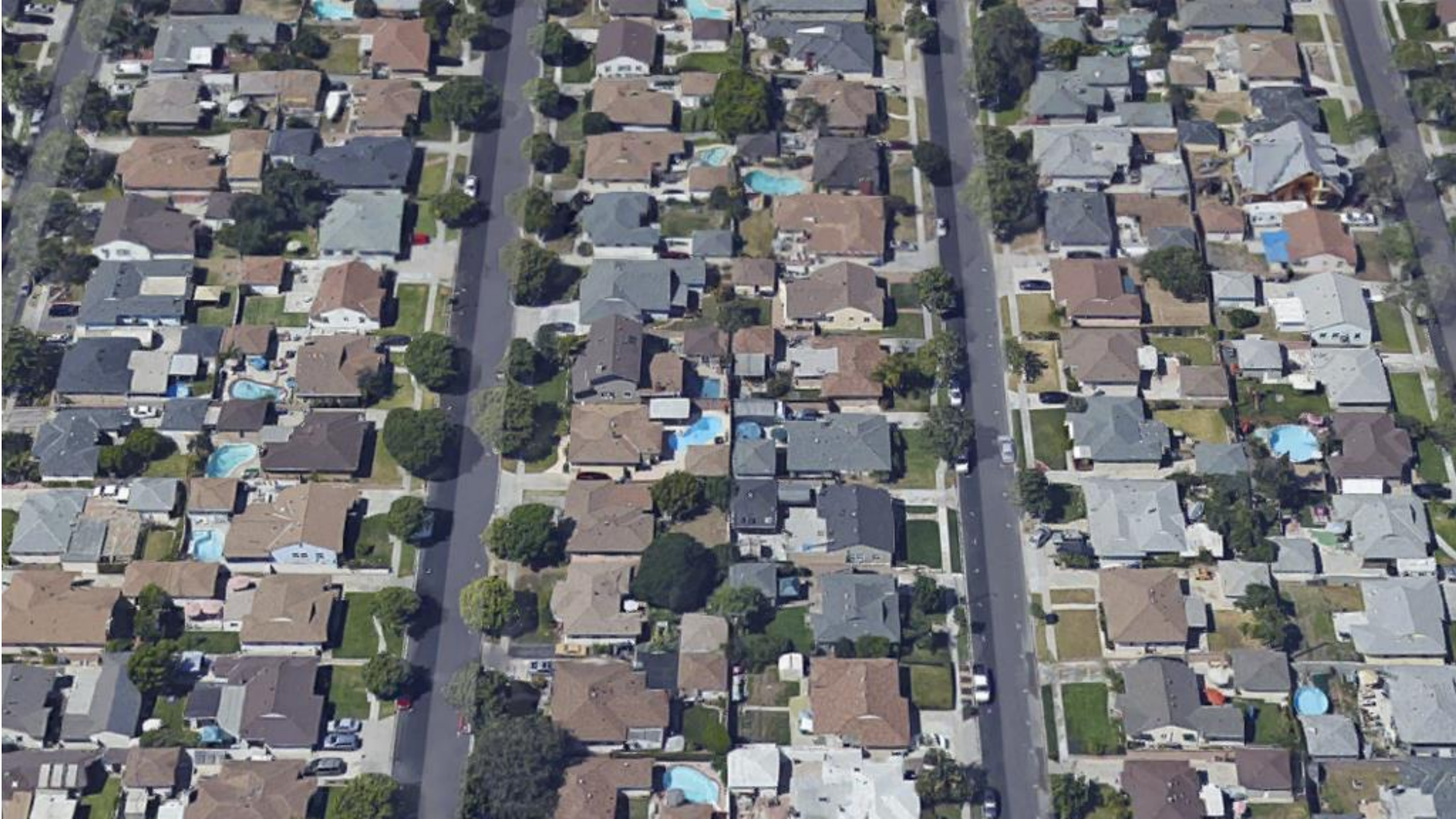


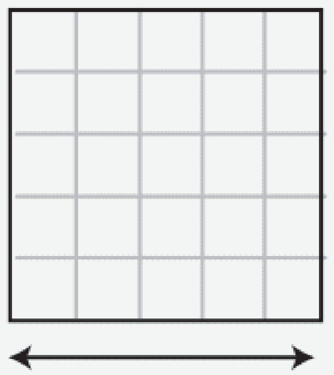
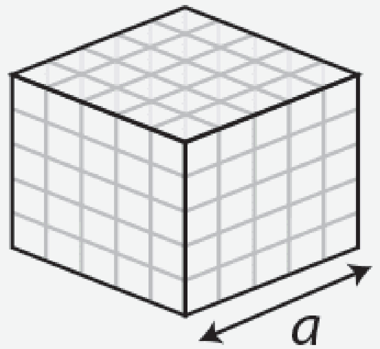
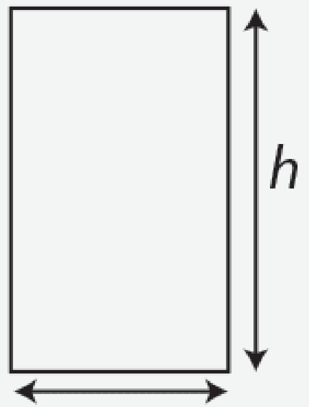
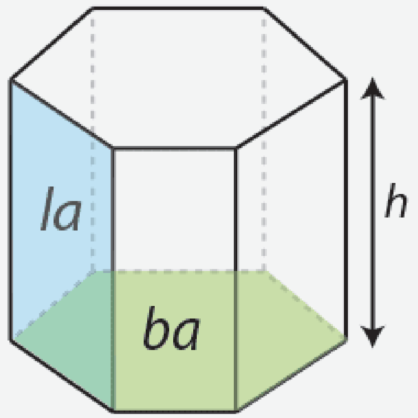
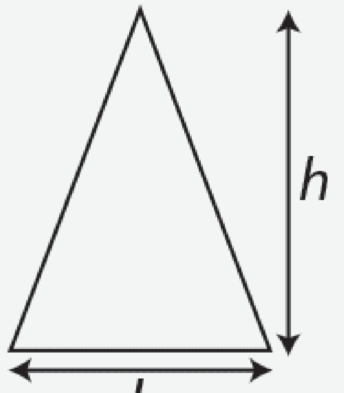
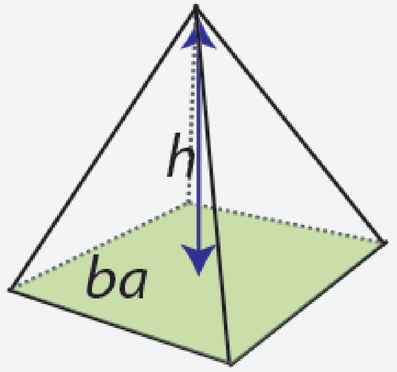
Example Write the function shown in the graph above.

Source: graphingstories.com

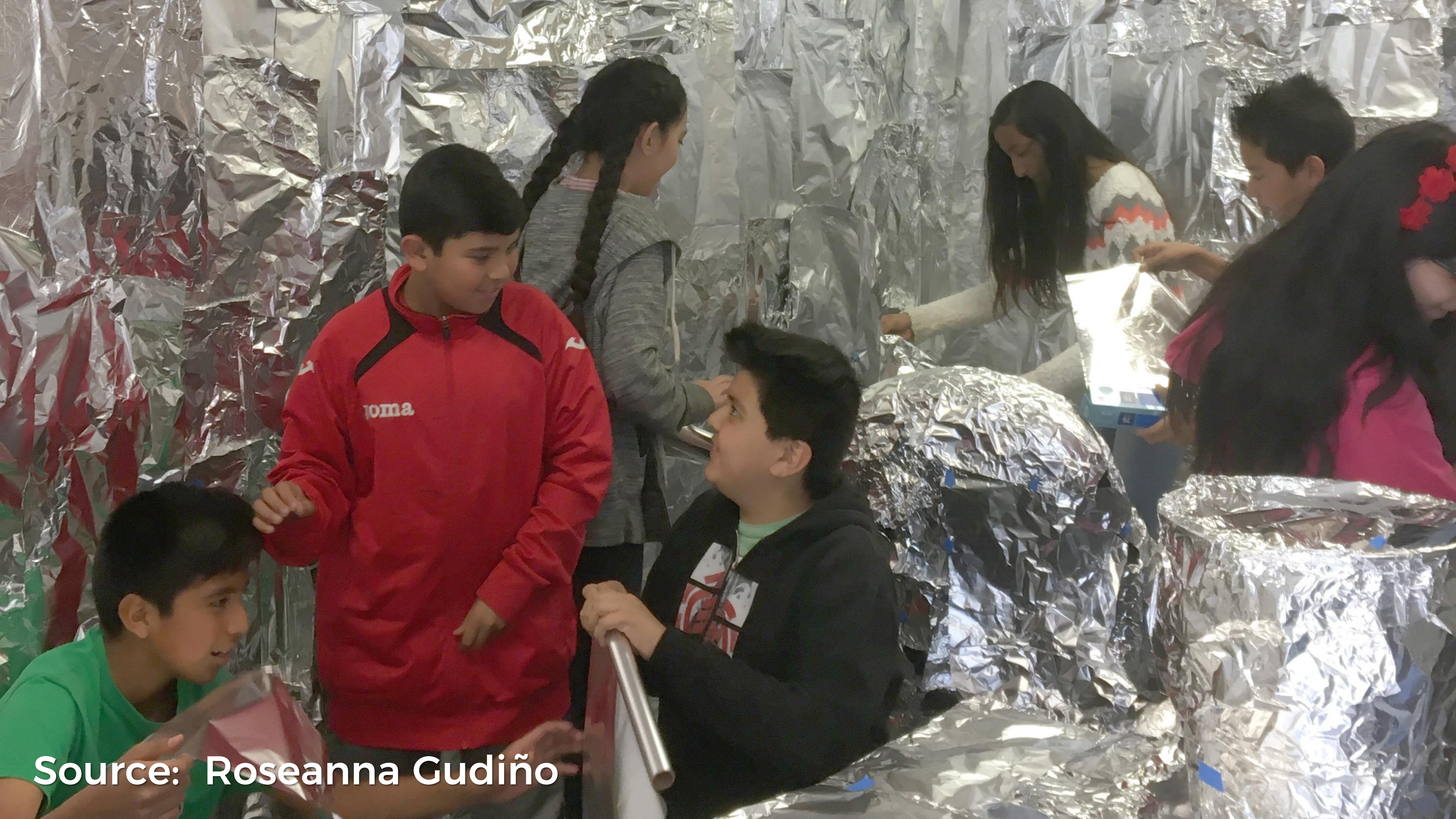
"Wait, was it a negative plus a negative or a negative times a negative that equals a positive."

TOO MANY STUDENTS



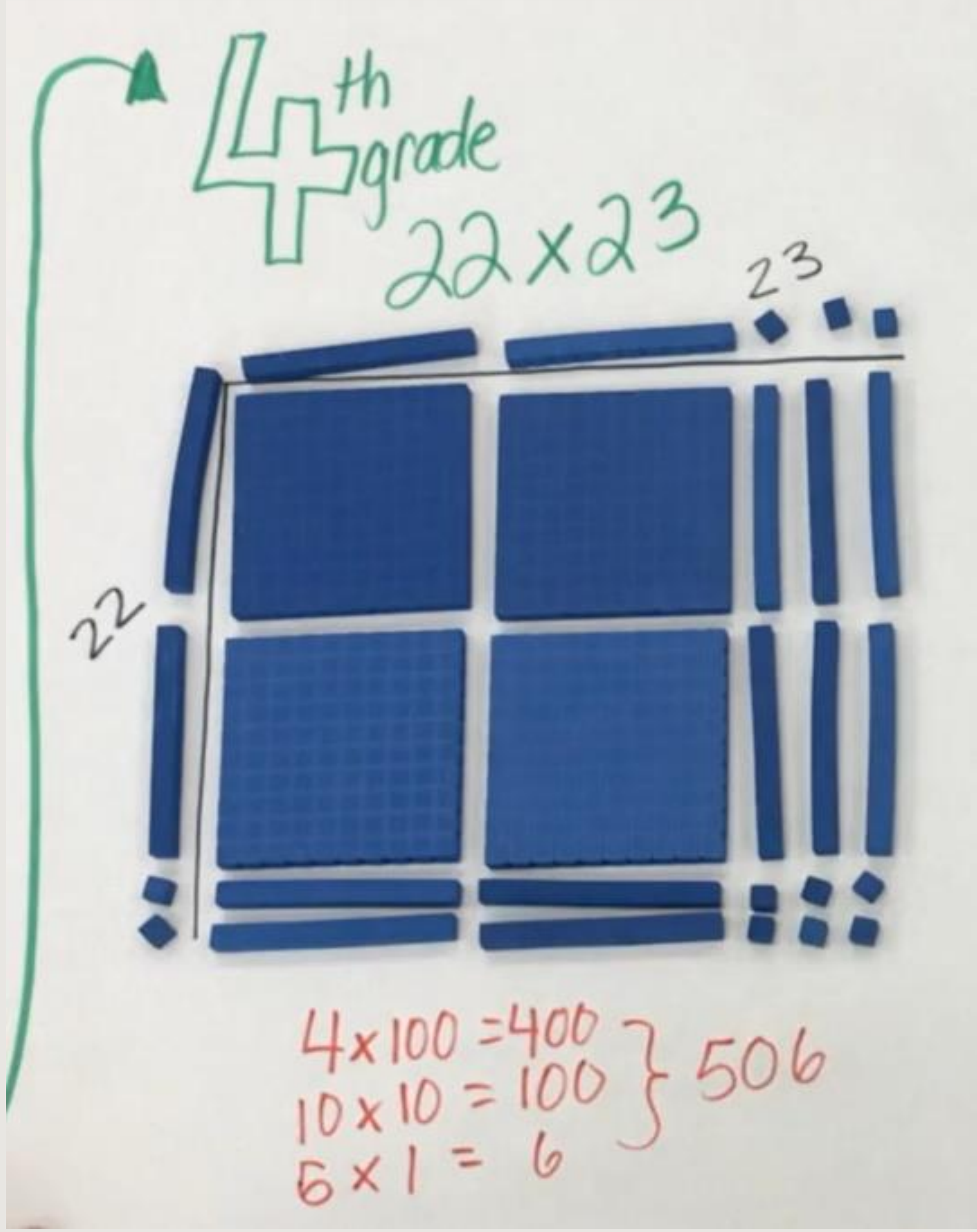
Two-dimensional plane shapes	**Area** *The measure of how many squares will fit into a shape.* ***Units²***	Three-dimensional solid shapes	**Surface Area** *The measure of the area of all outward facing sides.* ***Units²***	**Volume** *The measure of how many cubes will fit into a shape.* ***Units³***
Square 	Area = a^2 or $a \times a$ **Example:** *$a = 5cm$* *Area = $5^2 = 25cm^2$*	**Cube** 	Surface Area = $6 \times a^2$ **Example:** *$a = 5cm$* *Surface Area = $150cm^2$*	Volume = a^3 or $a \times a \times a$ **Example:** *$a = 5cm.$* *Volume = $125cm^3$*
Rectangle 	Area = $w \times h$ **Example:** *w = width=10cm* *height=20cm* *Area = $10 \times 20 = 200cm^2$*	**Prism** 	Surface Area = $2 \times$ ba + la **Example:** *ba = base area = $20cm^2$* *la = lateral area (all sides) = $60cm^2$* *Surface area =* *$2 \times 20 + 60 = 100cm^2$*	Volume = ba $\times$ h **Example:** *ba = base area = $20cm^2$* *h = height = 5cm* *Volume = $20 \times 5 = 100cm^3$*
Triangle 	Area = $b \times h \times 0.5$ **Example:** *b = base = 20cm* *h = vertical height = 15cm* *Area = $20 \times 15 \times 0.5 = 150cm^2$*	**Pyramid** 	Surface Area = ba + la **Example:** *ba = base area = $16cm^2$* *la = lateral area (all sides) = $60cm^2$* *Surface area = $16 + 60 = 76cm^2$*	Volume = ba $\times$ h $\times$ 1/3 **Example:** *ba = base area = $16cm^2$* *h = height = 9cm* *Volume = $16 \times 9 \times 1/3 = 48cm^3$*
n	Area = $n \times s \times a \times 0.5$	on	Surface Area = fa $\times$ s	

Source: robertkaplinsky.com/lessons

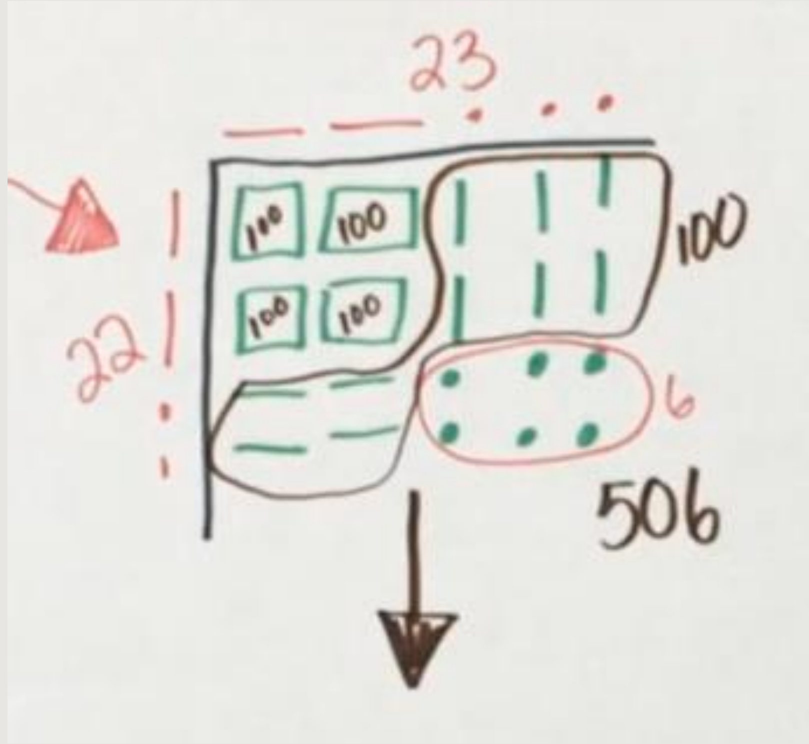


Source: Roseanna Gudiño

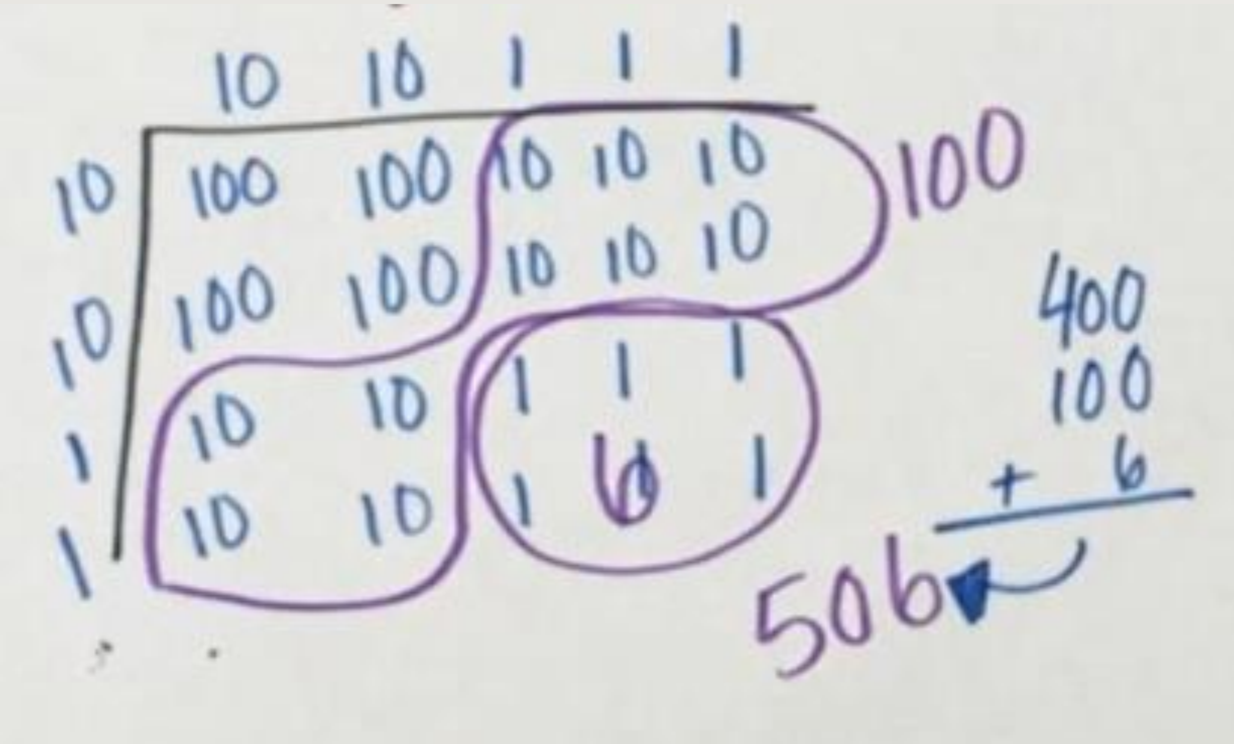
Source: gfletchy.com/progression-videos



Concrete



Representational



Abstract

Source: gfletchy.com

MY OLD METHODS

$$4(x + 3)$$

$$4(x) + 4(3)$$

$$(x + 3)(x - 1)$$

F $x(x)$

O $x(-1)$

I $3(x)$

L $3(-1)$

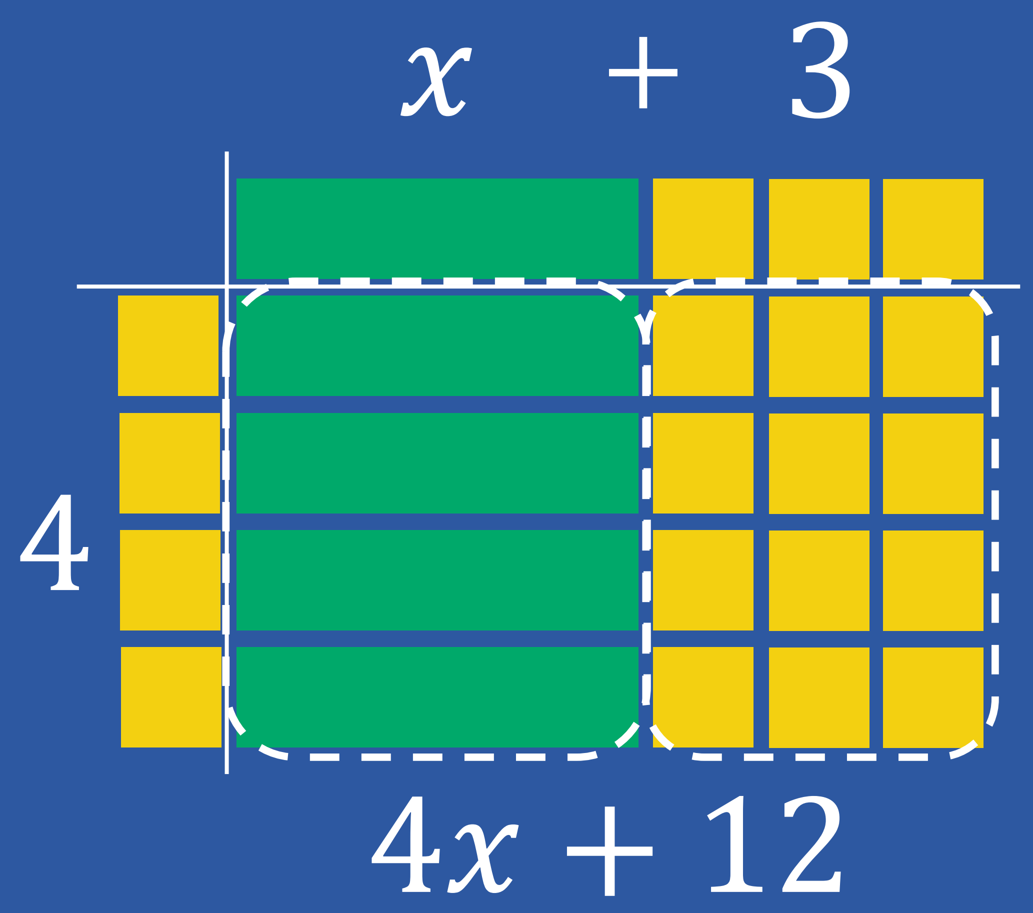
$$= x^2 - x + 3x - 3$$

$$= x^2 + 2x - 3$$

DISTRIBUTIVE PROPERTY

$$4(x+3)$$

Concrete



Representational

	x	$+\ 3$
4	$4x$	12

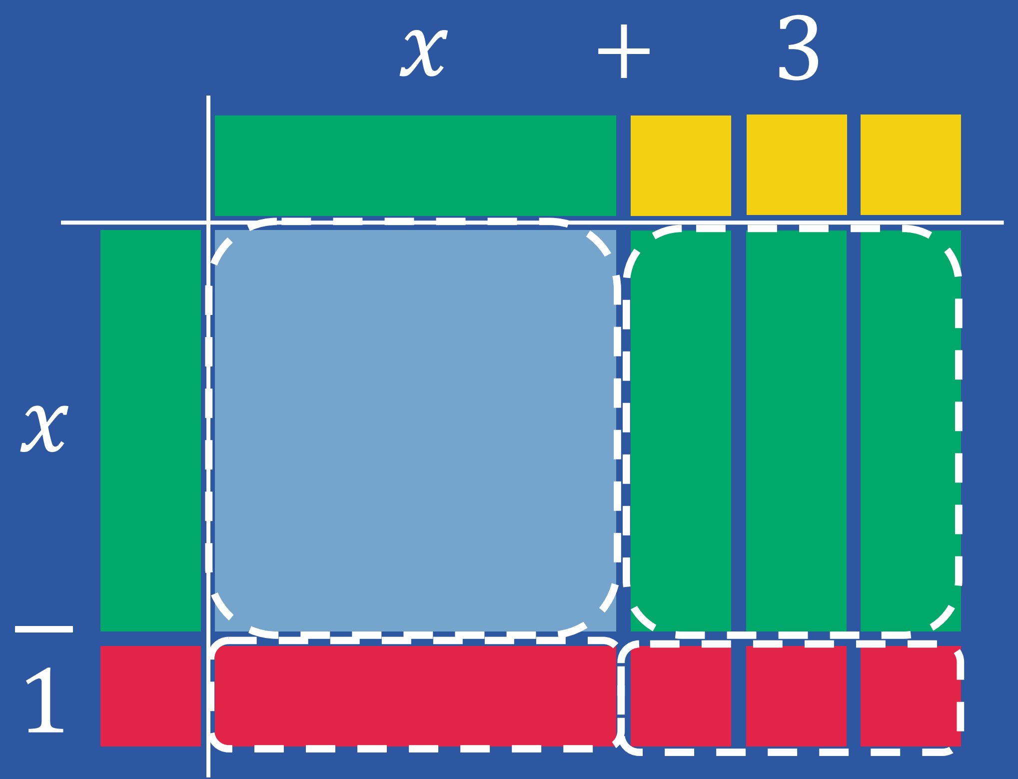
Abstract

$$4(x+3)$$
$$= 4(x) + 4(3)$$
$$= 4x + 12$$

BINOMIAL MULTIPLICATION

$$(x+3)(x-1)$$

Concrete



$$x^2 - x + 3x - 3$$

$$x^2 + 2x - 3$$

Representational

	x	$+\ 3$
x	x^2	3x
$-\ 1$	$-x$	-3

$$x^2 - x + 3x - 3$$

$$x^2 + 2x - 3$$

Abstract

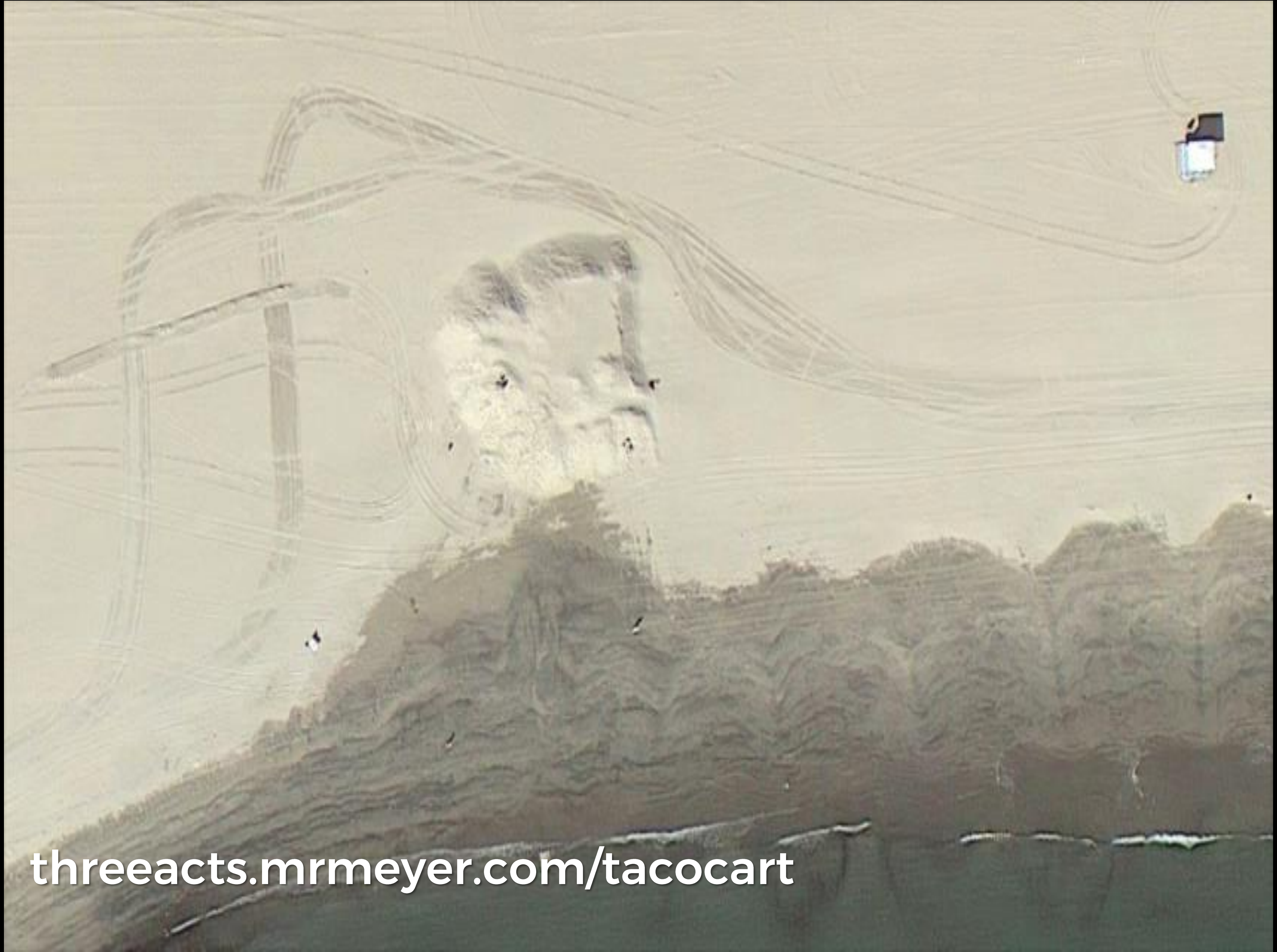
$$(x+3)(x-1)$$

$$= x^2 - x + 3x - 3$$

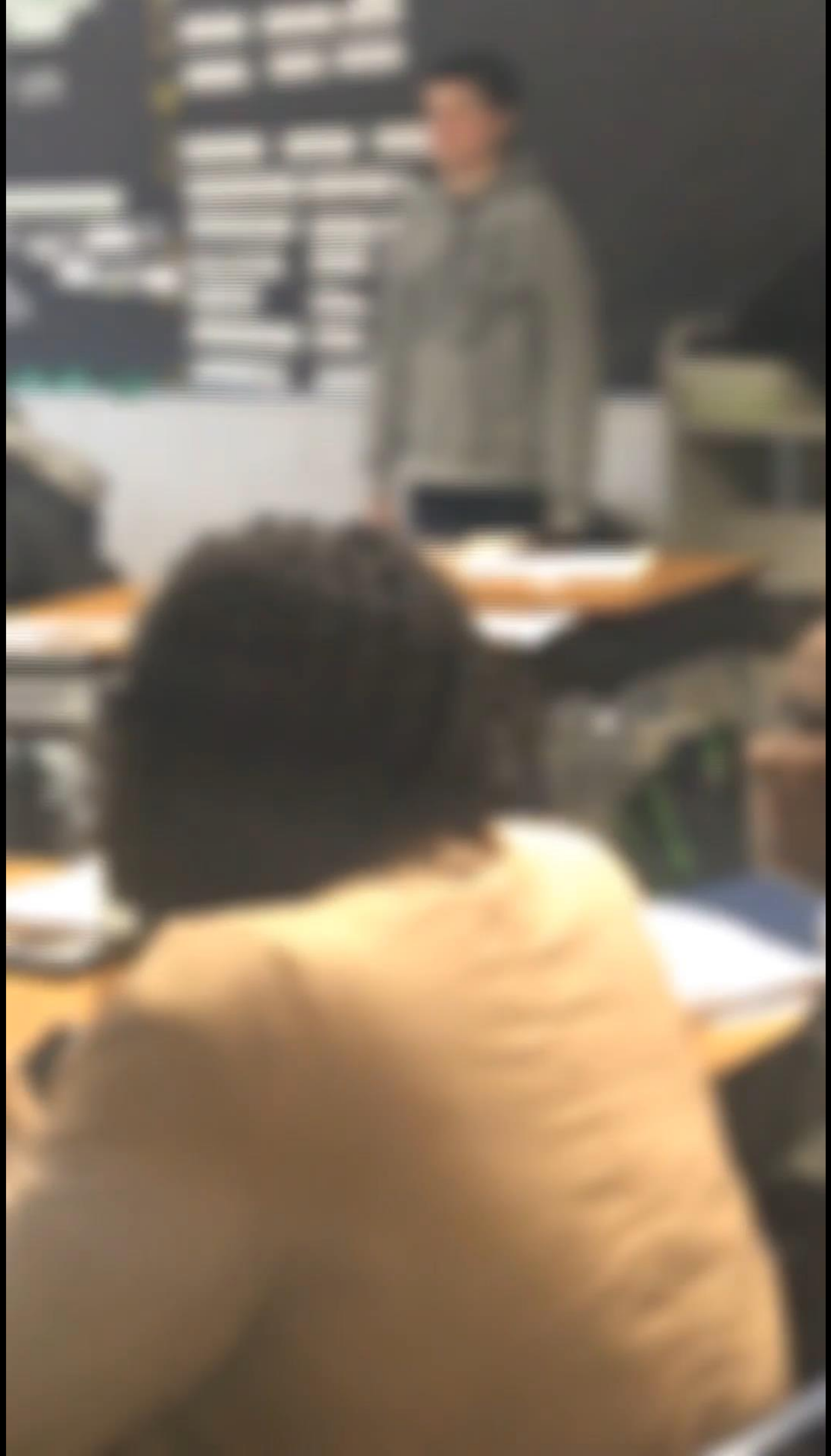
$$= x^2 + 2x - 3$$

STICKY ATTRIBUTES

- [x] SIMPLE
- [x] UNEXPECTED
- [x] CONCRETE
- [ ] CREDIBLE
- [ ] EMOTIONAL
- [ ] STORIES



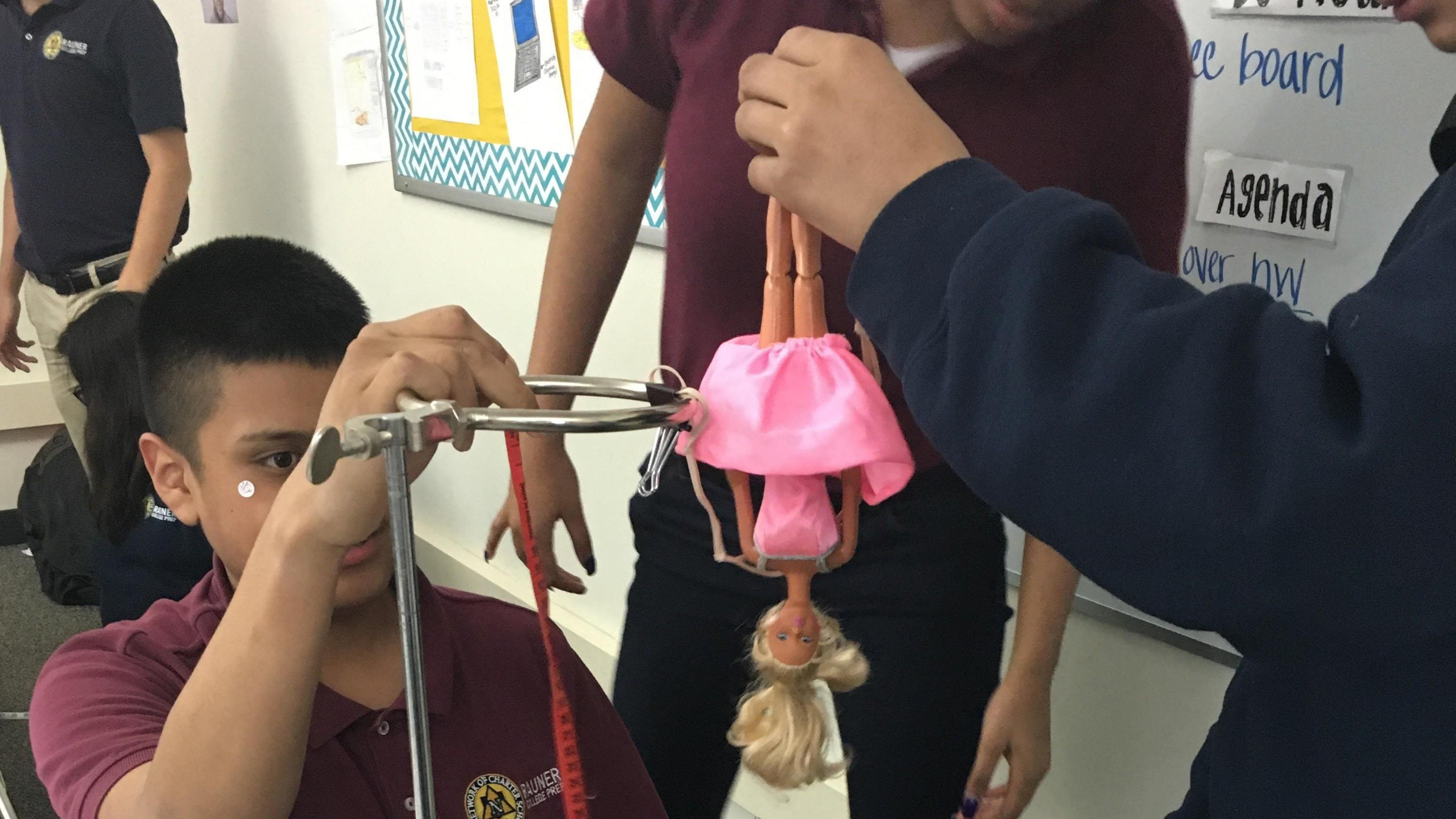
Source: threeacts.mrmeyer.com/tacocart



Source:
Jenise Sexton

Source: Tom Ward

Source: Tom Ward


Agenda

Source:
Fawn Nguyen


Division
Pain Relief Fever Reduction
NSAID
200 Tablets 200 mg
Functions
Pain Reliever/ Fever Reducer
Caffeine-Free
200 tablets
325 mg each
Extra Strength
Perimeter
Pain Reliever/ Fever Reducer
200 Capsules 500 mg. each

Act 1	Engaging Opener
Act 2	Get Info. Solve Problem.
Act 3	Big Reveal

STICKY ATTRIBUTES

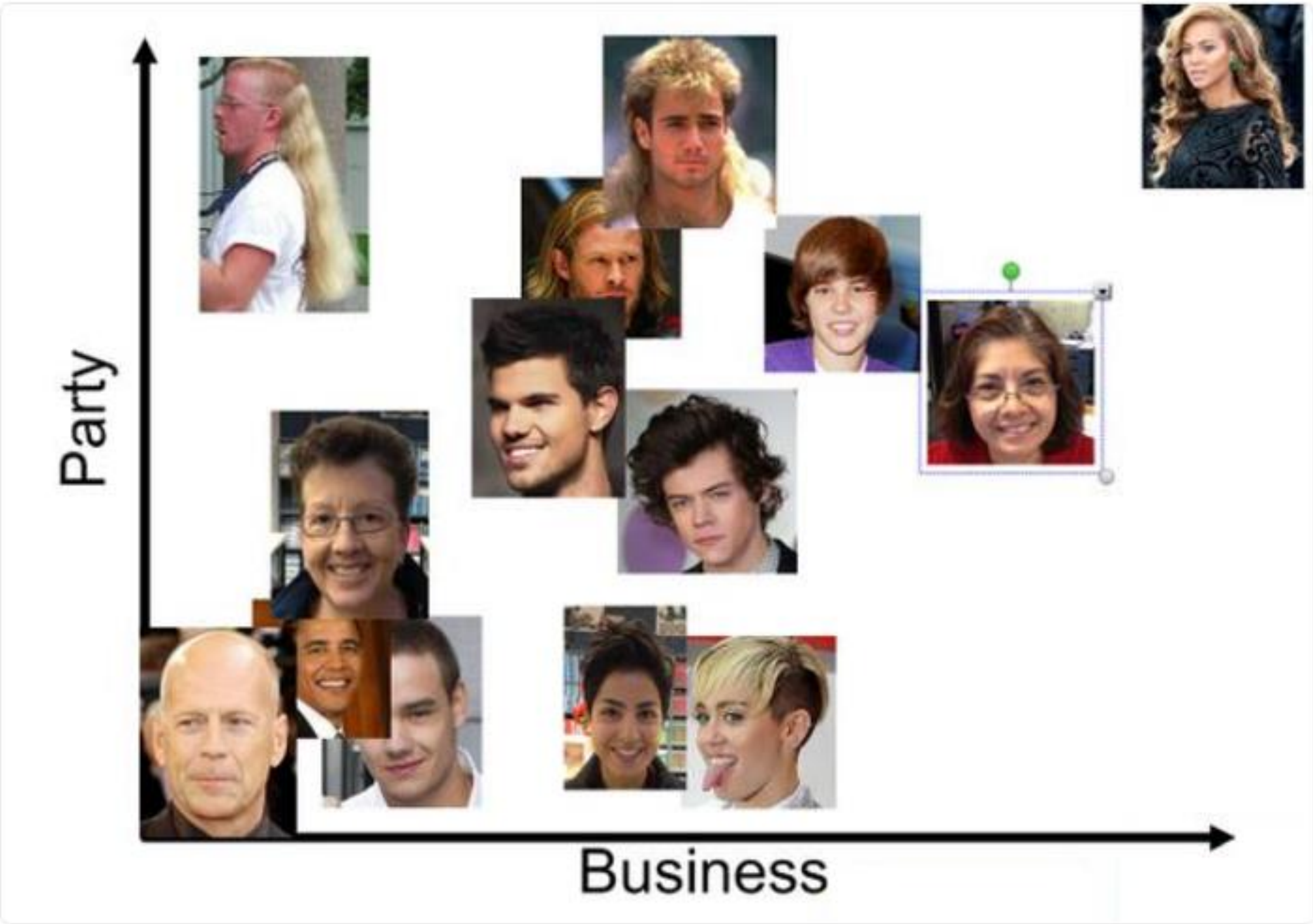
- ☑ SIMPLE
- ☑ UNEXPECTED
- ☑ CONCRETE
- ☑ CREDIBLE
- ☐ EMOTIONAL
- ☐ STORIES

Source: mrvaudrey.com

Matt Vaudrey
@MrVaudrey

Following

Things I never thought I'd say: "So you're saying that Thor has less party than Justin Bieber, but more than Obama?"



RETWEETS 4 LIKES 7

STICKY ATTRIBUTES

- [x] SIMPLE
- [x] UNEXPECTED
- [x] CONCRETE
- [x] CREDIBLE
- [x] EMOTIONAL
- [ ] STORIES

Source: robertkaplinsky.com/lessons

20. **Crime** Two men used ropes made from sheets to escape from a tall prison in Chicago. If they needed to make a total of 150 feet of rope and each sheet made 6 feet of rope, how many sheets did they need?

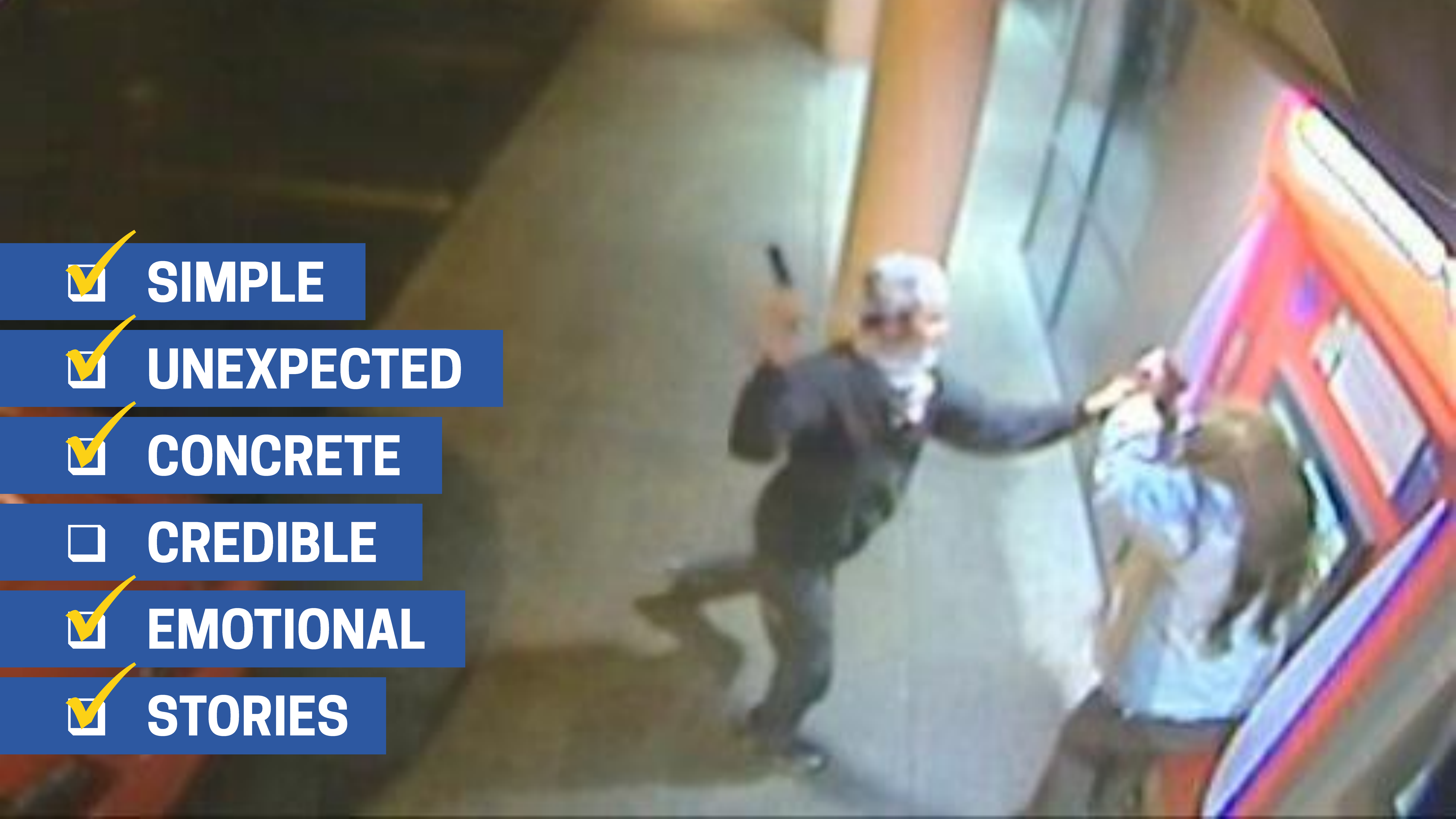
DO YOU SEE IT?

Via: Sara VanDerWerf

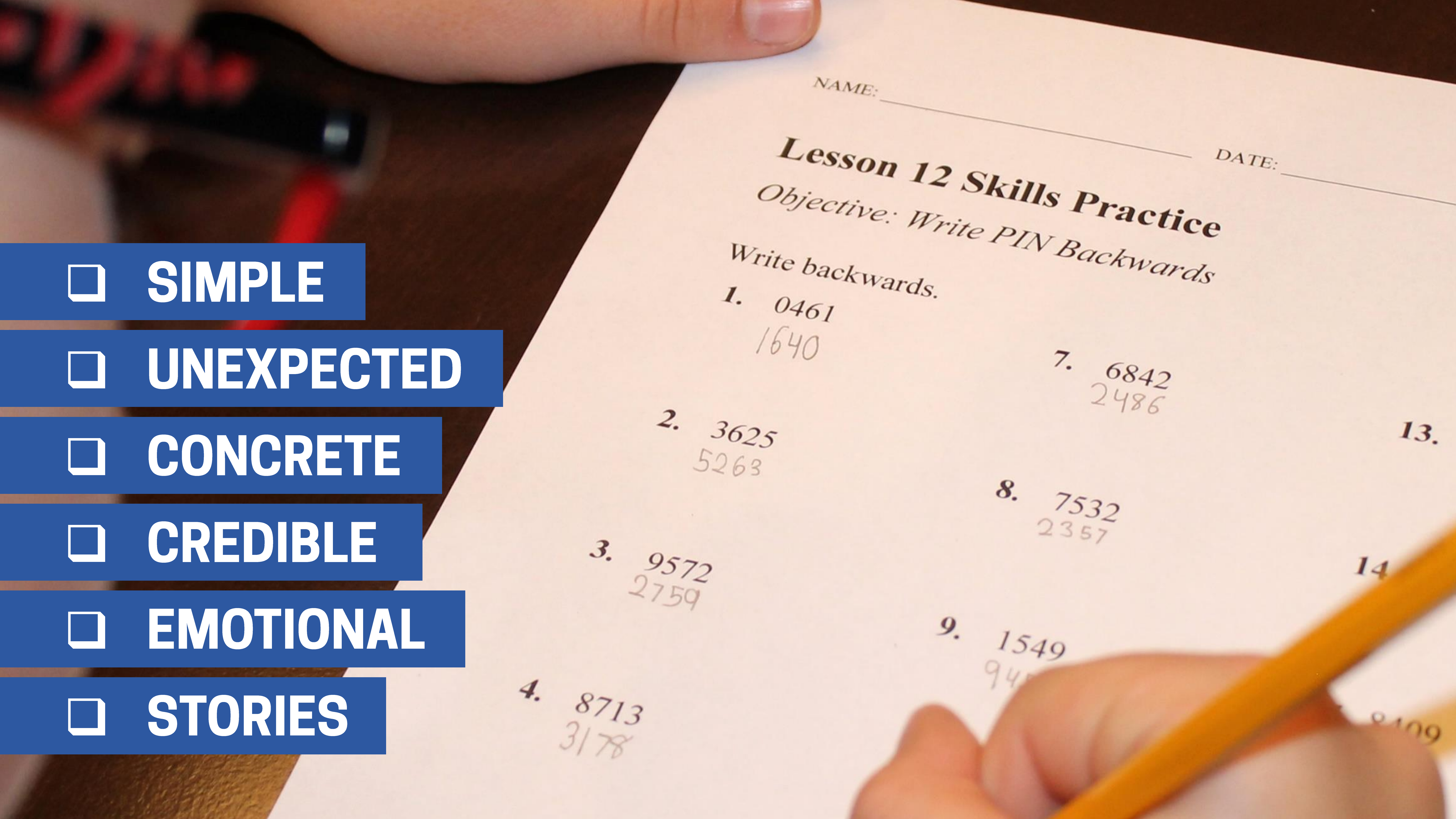
CURSE OF KNOWLEDGE

STICKY ATTRIBUTES

- ☑ SIMPLE
- ☑ UNEXPECTED
- ☑ CONCRETE
- ☑ CREDIBLE
- ☑ EMOTIONAL
- ☑ STORIES



SIMPLE
UNEXPECTED
CONCRETE
CREDIBLE
EMOTIONAL
STORIES


❑ SIMPLE
❑ UNEXPECTED
❑ CONCRETE
❑ CREDIBLE
❑ EMOTIONAL
❑ STORIES
NAME:
DATE:
Lesson 12 Skills Practice
Objective: Write PIN Backwards
Write backwards.
1. 0461
1640
2. 3625
5263
3. 9572
2759
4. 8713
3178
7. 6842
2486
8. 7532
2357
9. 1549
13.

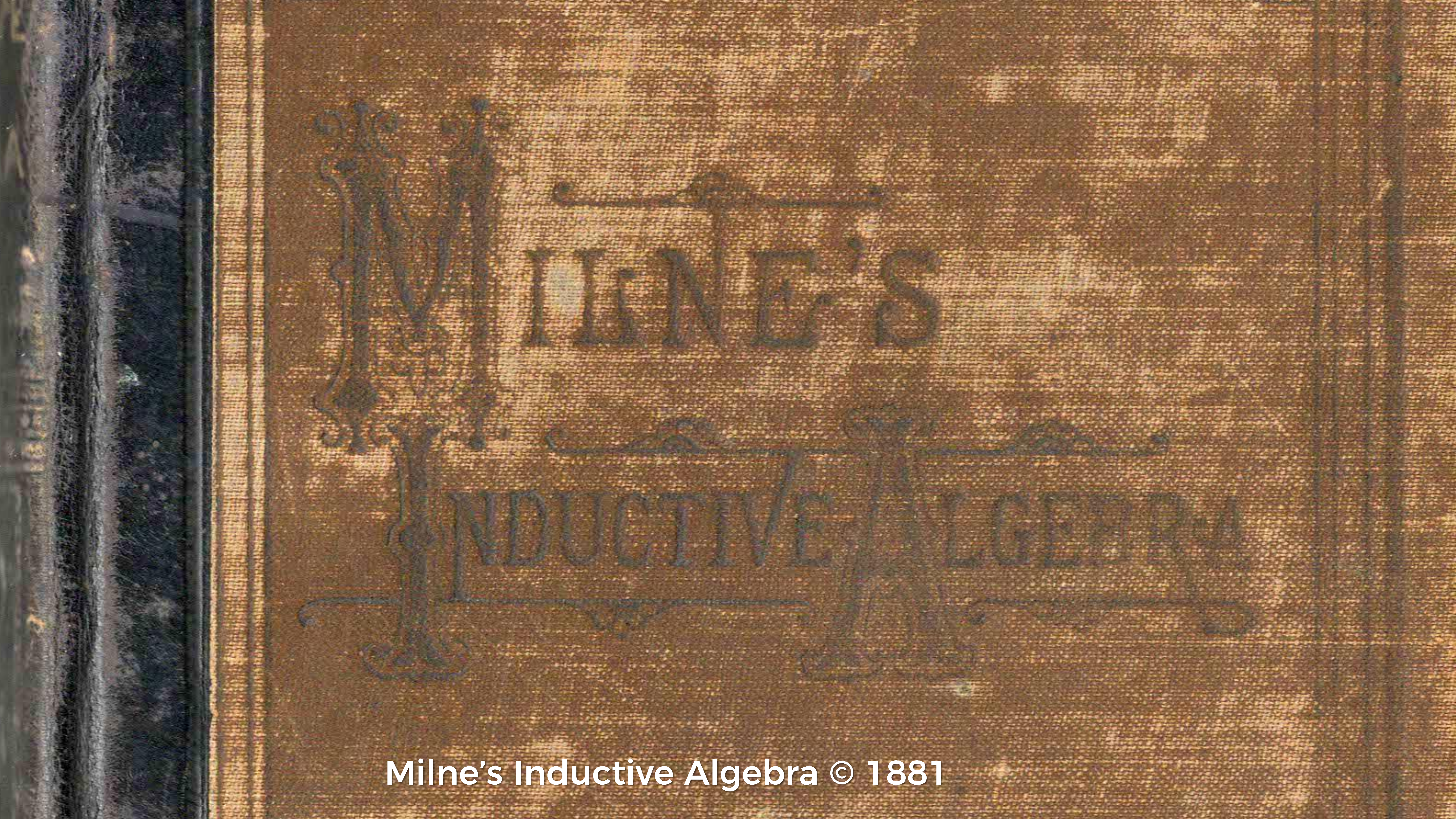
DISCUSSION TIME

- Why are urban legends so much easier to remember?
- How can we use that knowledge to make math easier to remember too?

GOALS

- ☑ CORRECT ANSWERS = UNDERSTANDING?
- ☑ MAKE OUR LESSONS UNFORGETTABLE
- ☐ RECONSIDER USING WORD PROBLEMS
- ☐ MAKE MATH CHALLENGING + ACCESSIBLE

Why do we have word problems?



Milne's Inductive Algebra © 1881

183. Directions for Solving.—*Represent one of the unknown quantities by x, and from the conditions of the problem find an expression for each of the other quantities given.*

Find from the problem two expressions that are equal, and express them as an equation.

Solve the equation.

51. When the half of a certain number is added to the number, the sum is as much more than 60 as the number is less than 65. What is the number? 50 ans.

52. The difference between two numbers is 8, and the quotient arising from dividing the greater by the less is 3. What are the numbers?

53. A man left one-half of his property to his wife, one-sixth to his children, a twelfth to his brother, and the rest, which was $600, to charitable purposes. How much property had he?

C CIRCLE the numbers

U UNDERLINE the question

B BOX the key words

E ~~ELIMINATE~~ info not needed

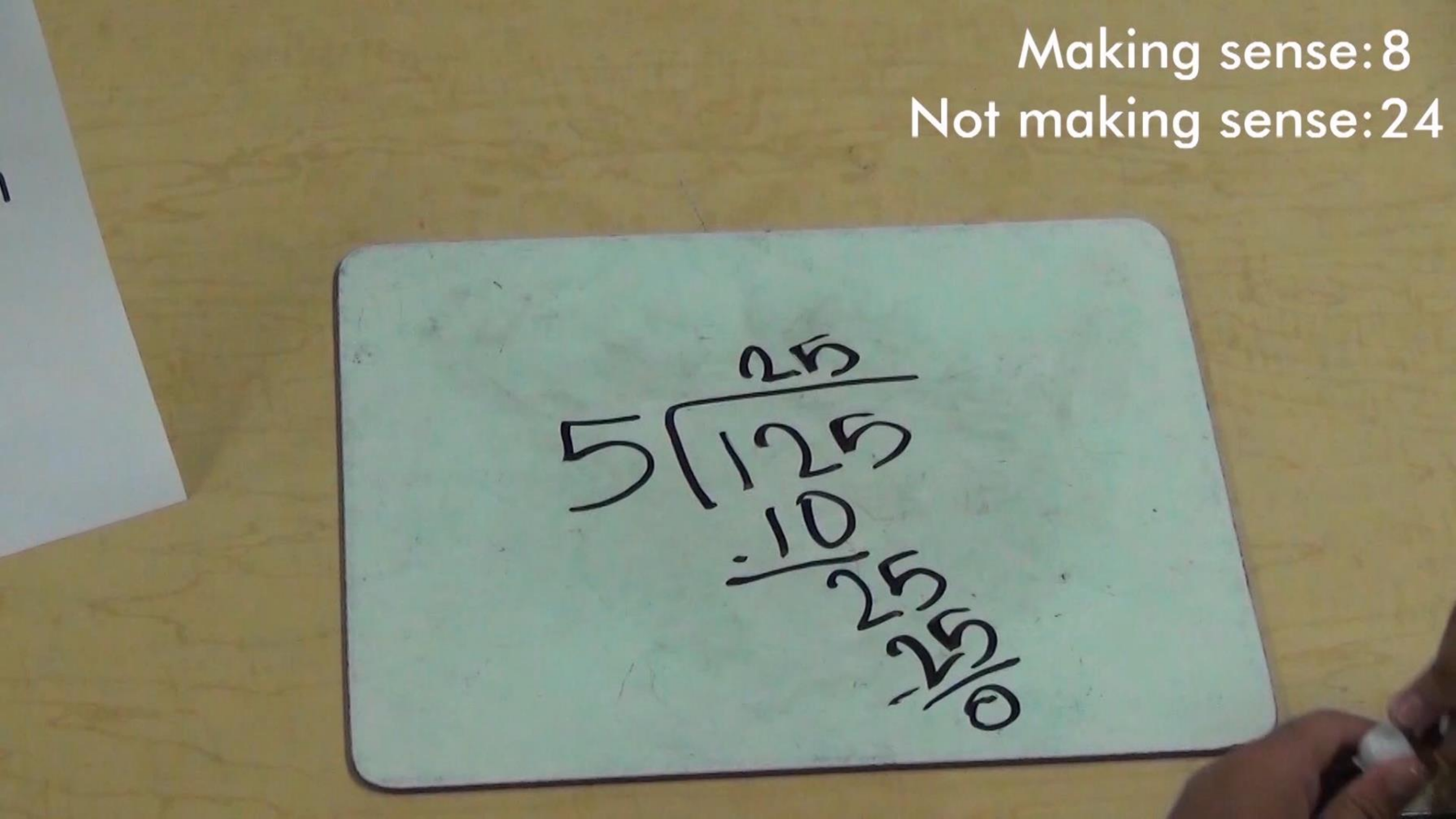
S SOLVE and check ✓

~~Each school bus holds~~ 60 ~~students and there are~~ *n* ~~students going on a field trip.~~ How many buses will be needed altogether?

Source: Marilyn Burns

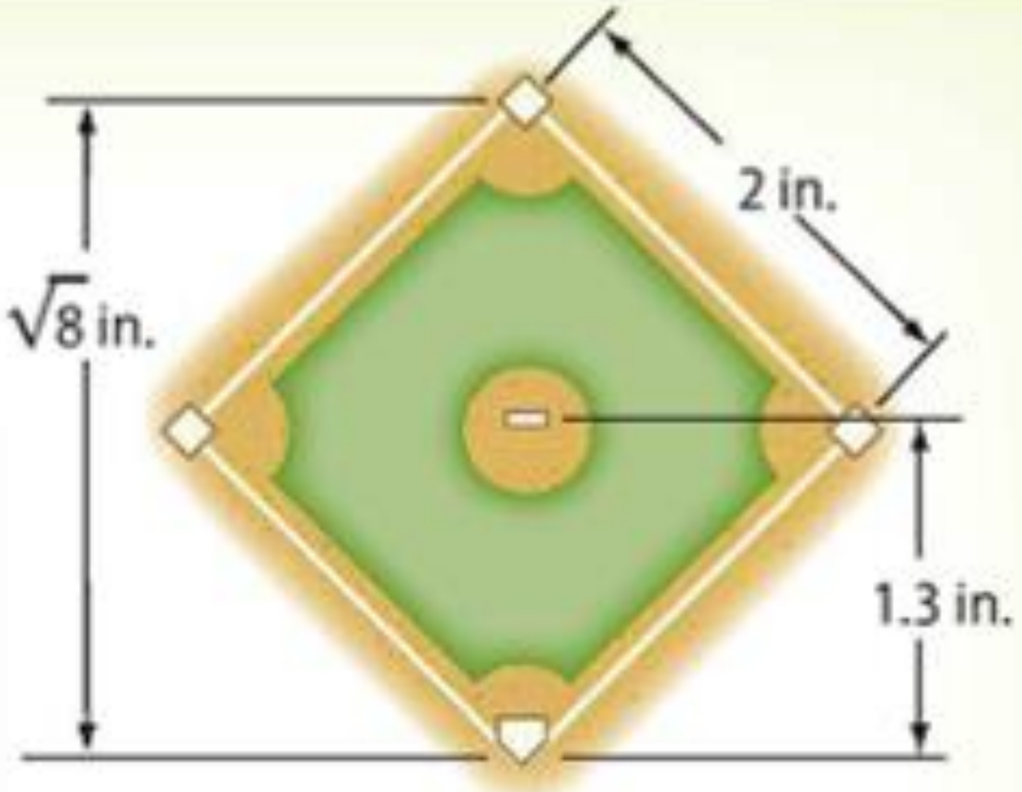
There are 125 sheep and 5 dogs in a flock. How old is the shepherd?

What does it look like when students make sense of problems?


Making sense: 8
Not making sense: 24

Real-World Link

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

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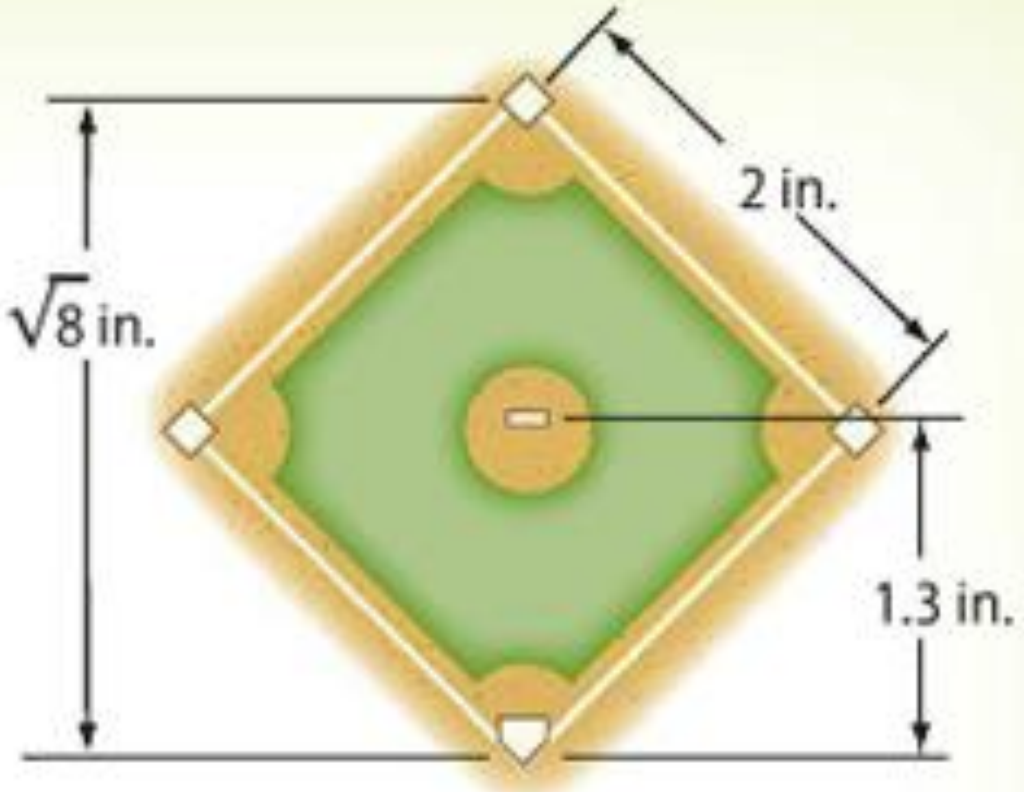

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CCSS Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6


Doritos
NACHO CHEESE
Doritos
COOL RANCH
Cheetos
Puffs
Cheetos
Crunchy
Doritos® & Cheetos® Mix
BRAND
BRAND
20 Singles
DORITOS® Nacho Cheese Flavored Tortilla Chips 1 OZ. EA. DORITOS® COOL RANCH® Flavored Tortilla Chips1 OZ. EA. CHEETOS® Puffs Cheese Flavored Snacks 7/8 OZ. EA. CHEETOS® Crunchy Cheese Flavored Snacks 1 OZ. EA.
20 INDIVIDUAL BAGS: 7/8 OZ. EACH, 1 OZ. EACH, TOTAL NET WT. 19 5/8 OZ. (1 LB. 3 5/8 OZ.) 556.3 g
⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

THINKING TIME

- Why did many of you expect there to be five of each?
- Why was it not five of each?
- How might they decide on this combination?

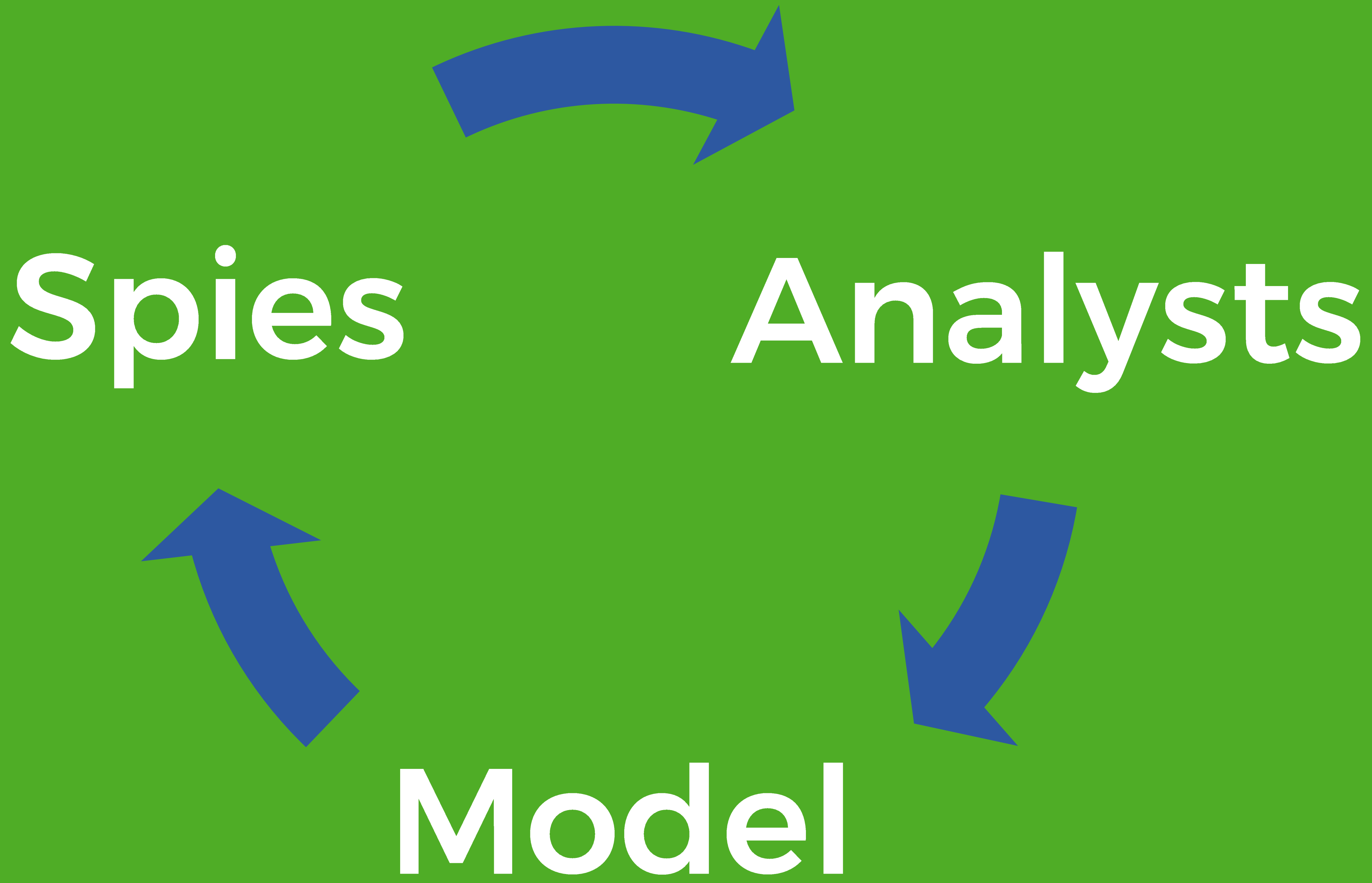
Lay's
Classic
Doritos
NACHO CHEESE
Doritos
COOL RANCH
Cheetos
Crunchy
Sun Chips
ORIGINAL
Fritos
BRAND
The ORIGINAL
CORN CHIPS
Classic Mix
20
Singles
LAY'S® Classic Potato Chips, DORITOS® Nacho Cheese Flavored Tortilla Chips, DORITOS® COOL RANCH® Flavored Tortilla Chips, CHEETOS® Crunchy Cheese Flavored Snacks, SUNCHIPS® Original Multigrain Snacks, FRITOS® Original Corn Chips (All 1 OZ. Each)
20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g
⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

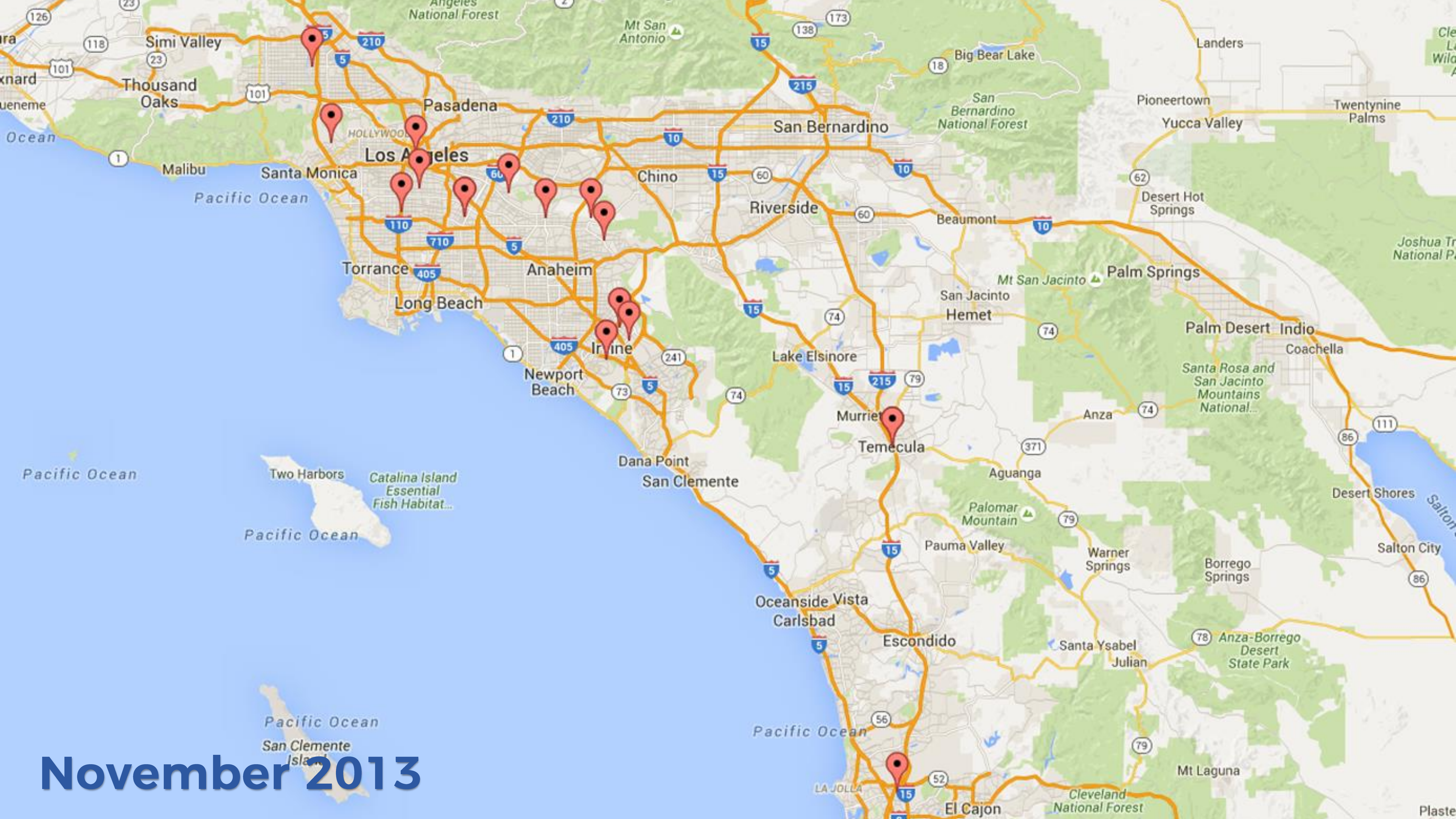
MATH MODELING

- ❑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ❑ IS IT JUST ANSWERING QUESTIONS?
- ❑ HOW IS MATH MODELING USED IN REAL LIFE?
- ❑ HOW DO WE HELP OUR STUDENTS IMPROVE?

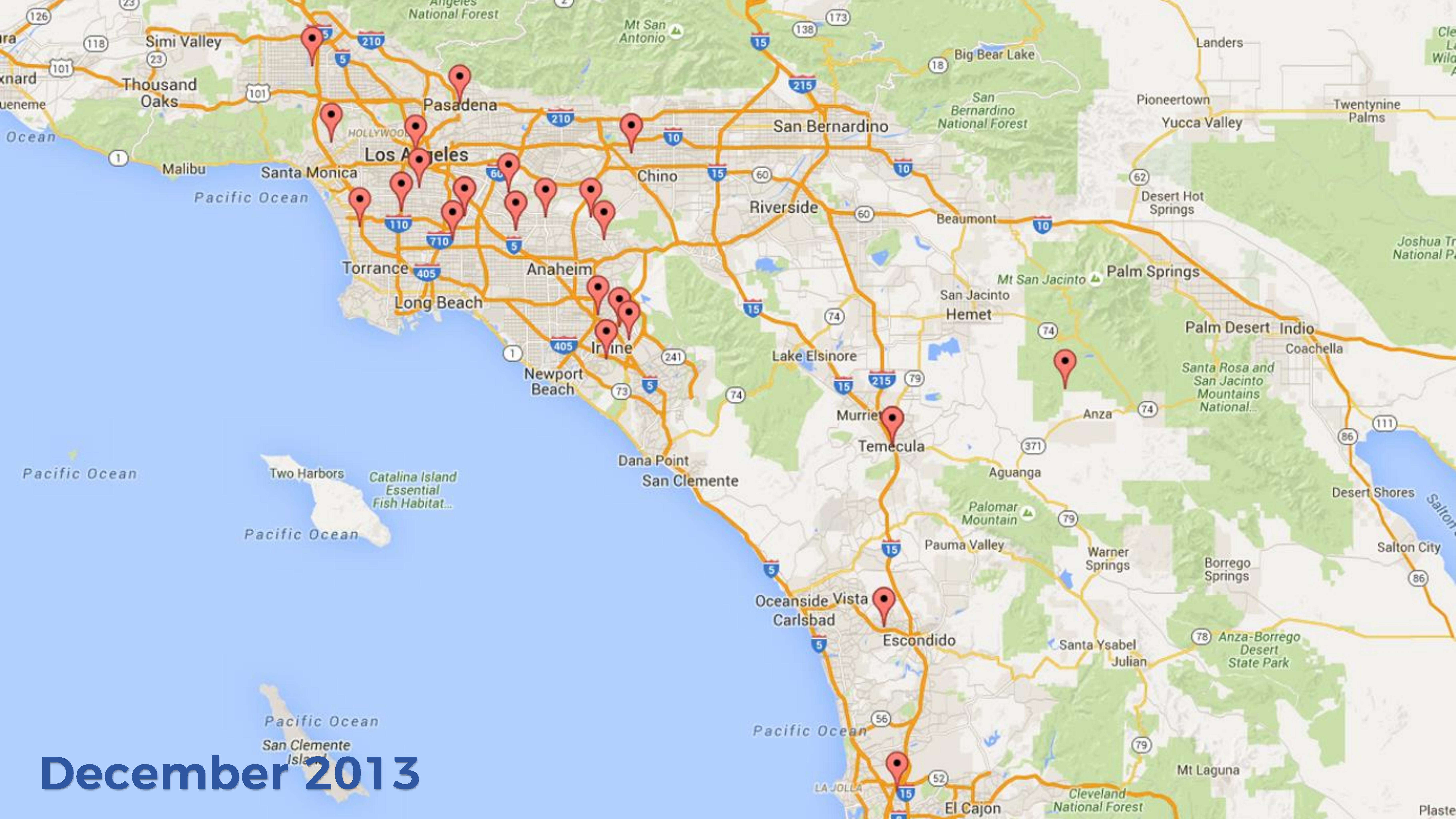
CENTRAL INTELLIGENCE AGENCY

UNITED STATES OF AMERICA


Spies
Analysts
Model



November 2013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Mt San Antonio
Big Bear Lake
Landers
Pioneertown
Twentynine Palms
Yucca Valley
San Bernardino
San Bernardino National Forest
Los Angeles
Santa Monica
Malibu
Pacific Ocean
Chino
Riverside
Beaumont
Desert Hot Springs
Joshua Tree National Park
Palm Springs
Mt San Jacinto
San Jacinto
Hemet
Palm Desert
Indio
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Torrance
Long Beach
Anaheim
Irvine
Newport Beach
Lake Elsinore
Murrieta
Temecula
Anza
Santa Rosa and San Jacinto Mountains National...
Aguanga
Dana Point
San Clemente
Two Harbors
Catalina Island Essential Fish Habitat...
Palomar Mountain
Pauma Valley
Warner Springs
Borrego Springs
Desert Shores
Salton City
Oceanside
Vista
Carlsbad
Escondido
Santa Ysabel
Julian
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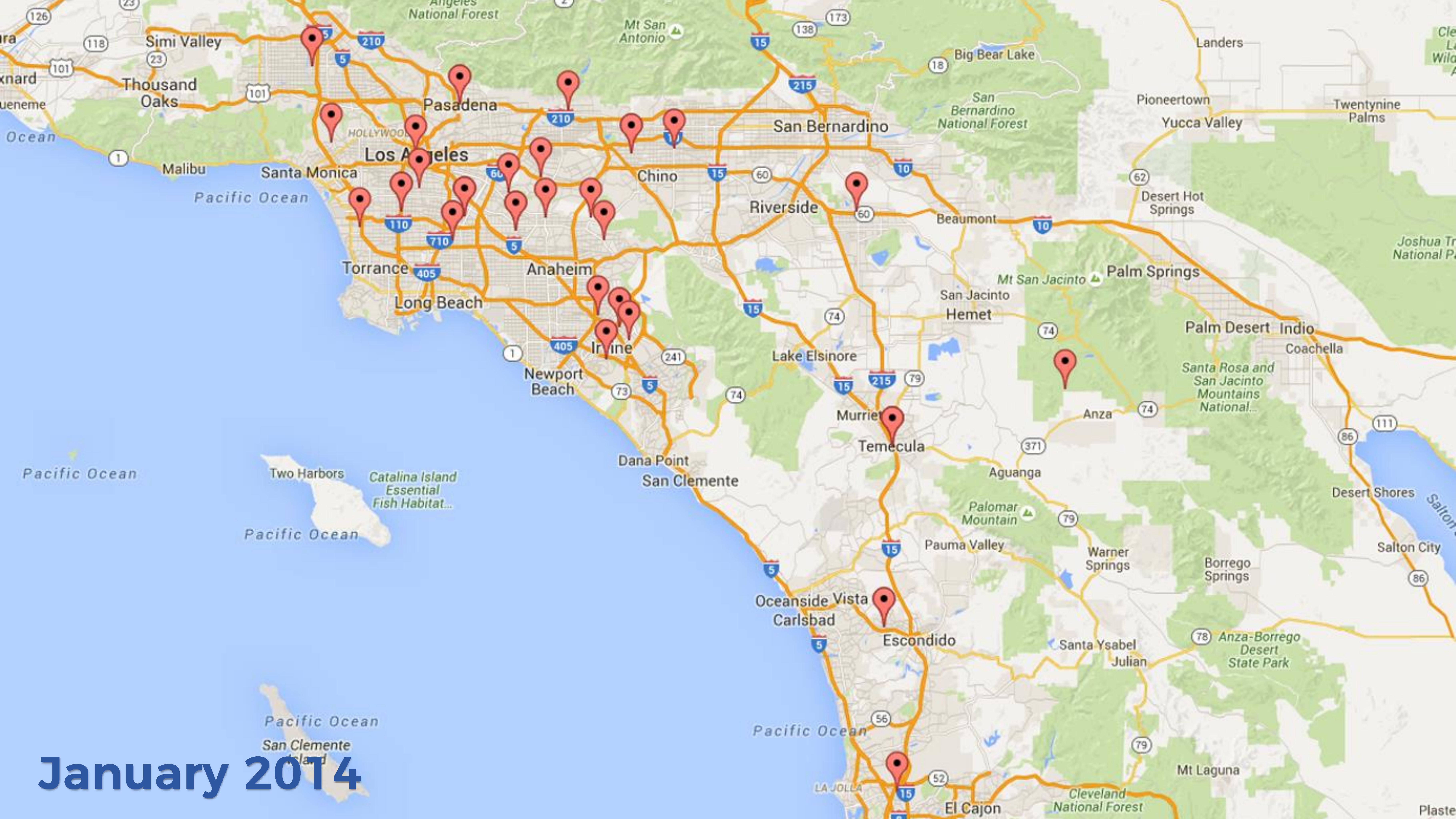
El Cajon
Cleveland National Forest
La Jolla
December 2013



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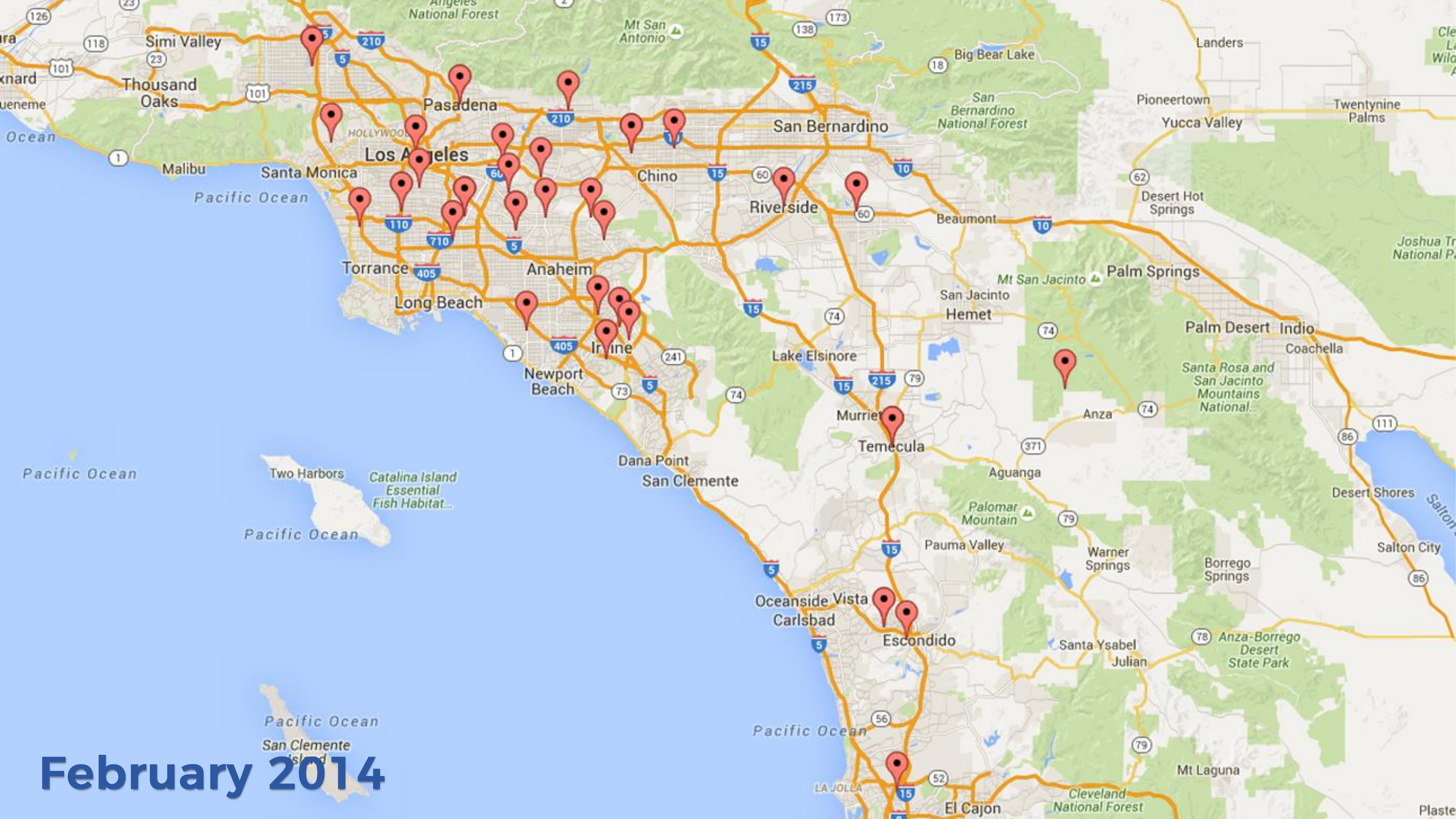

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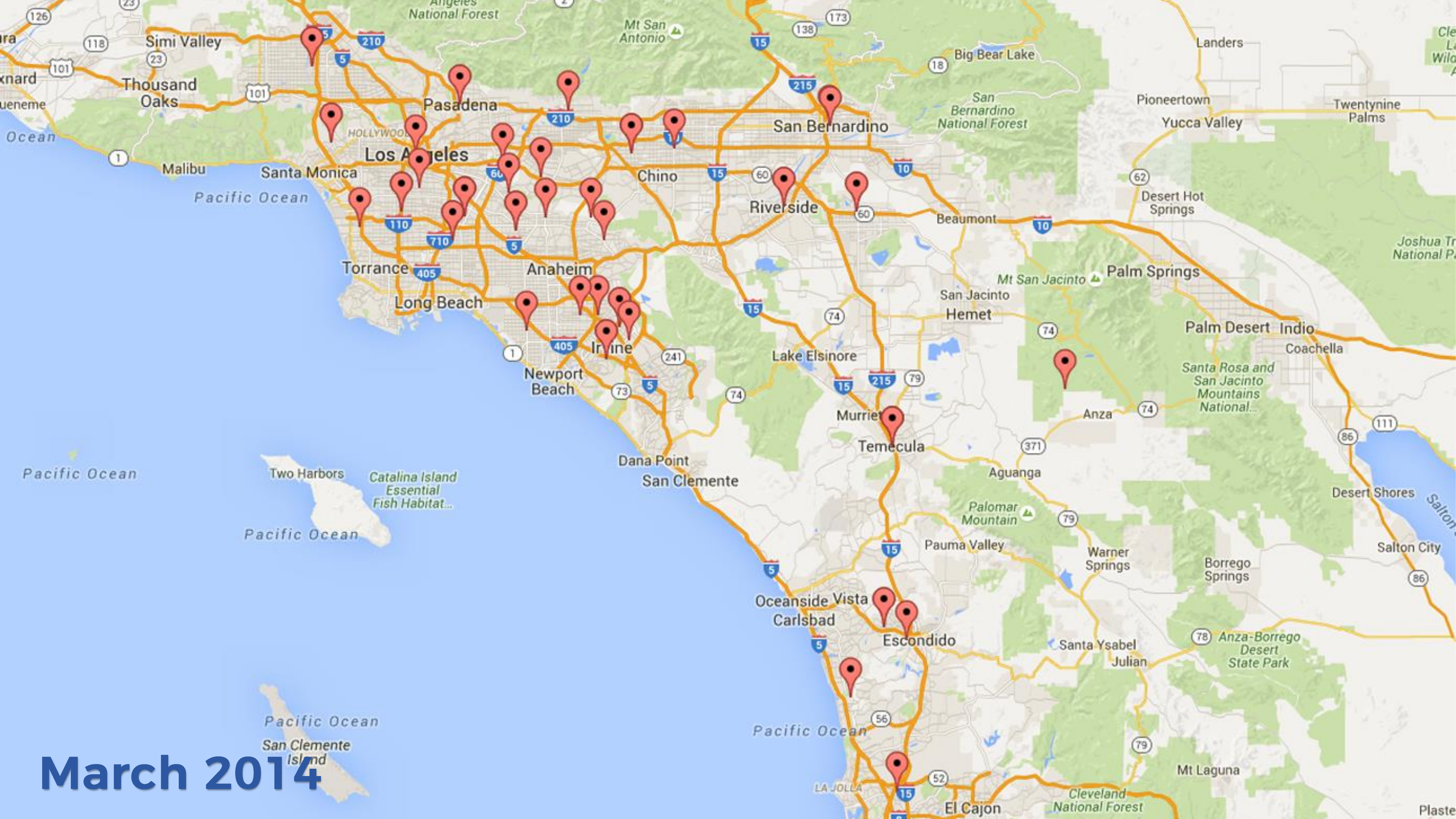
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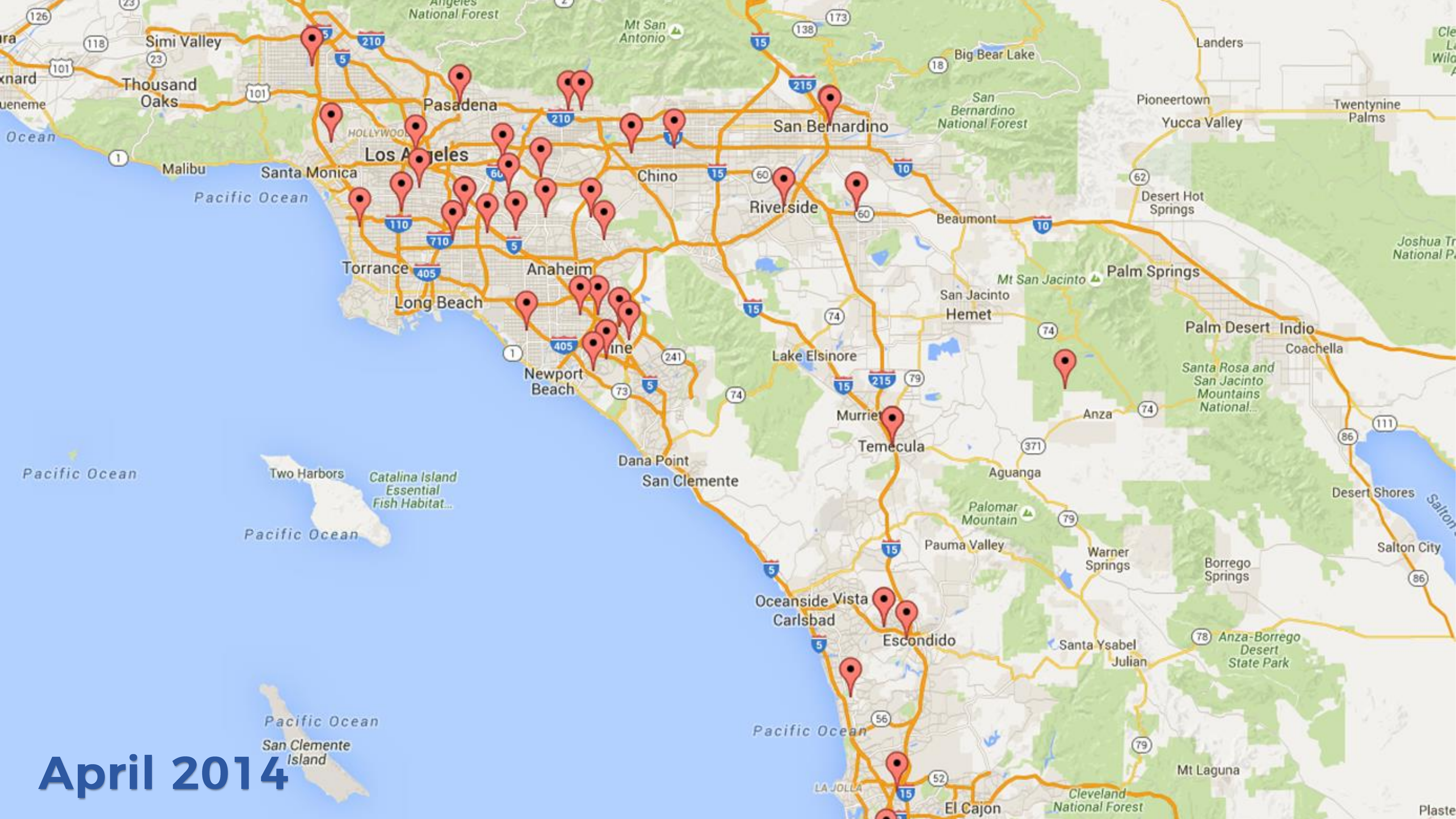
March 2014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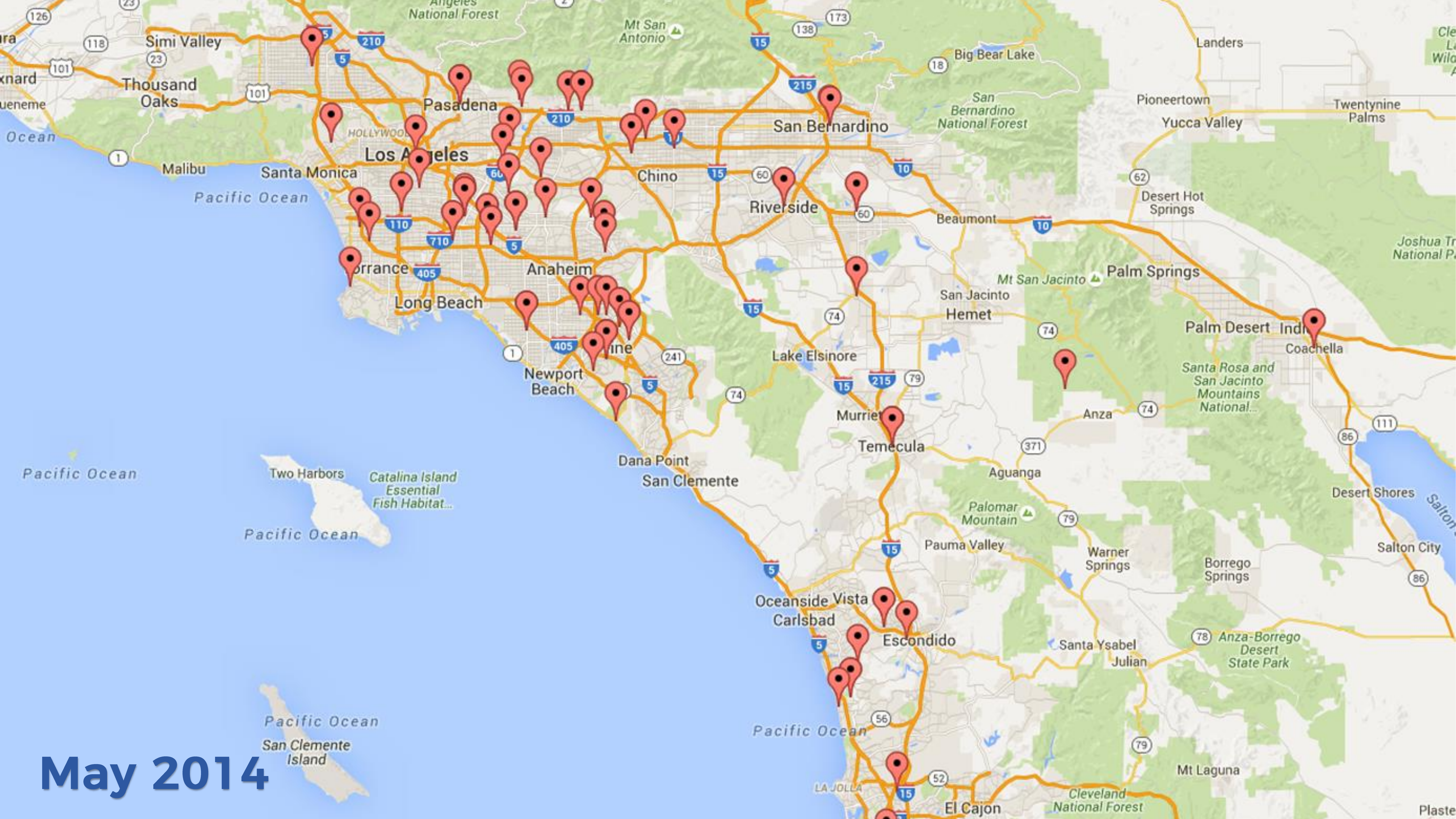
April 2014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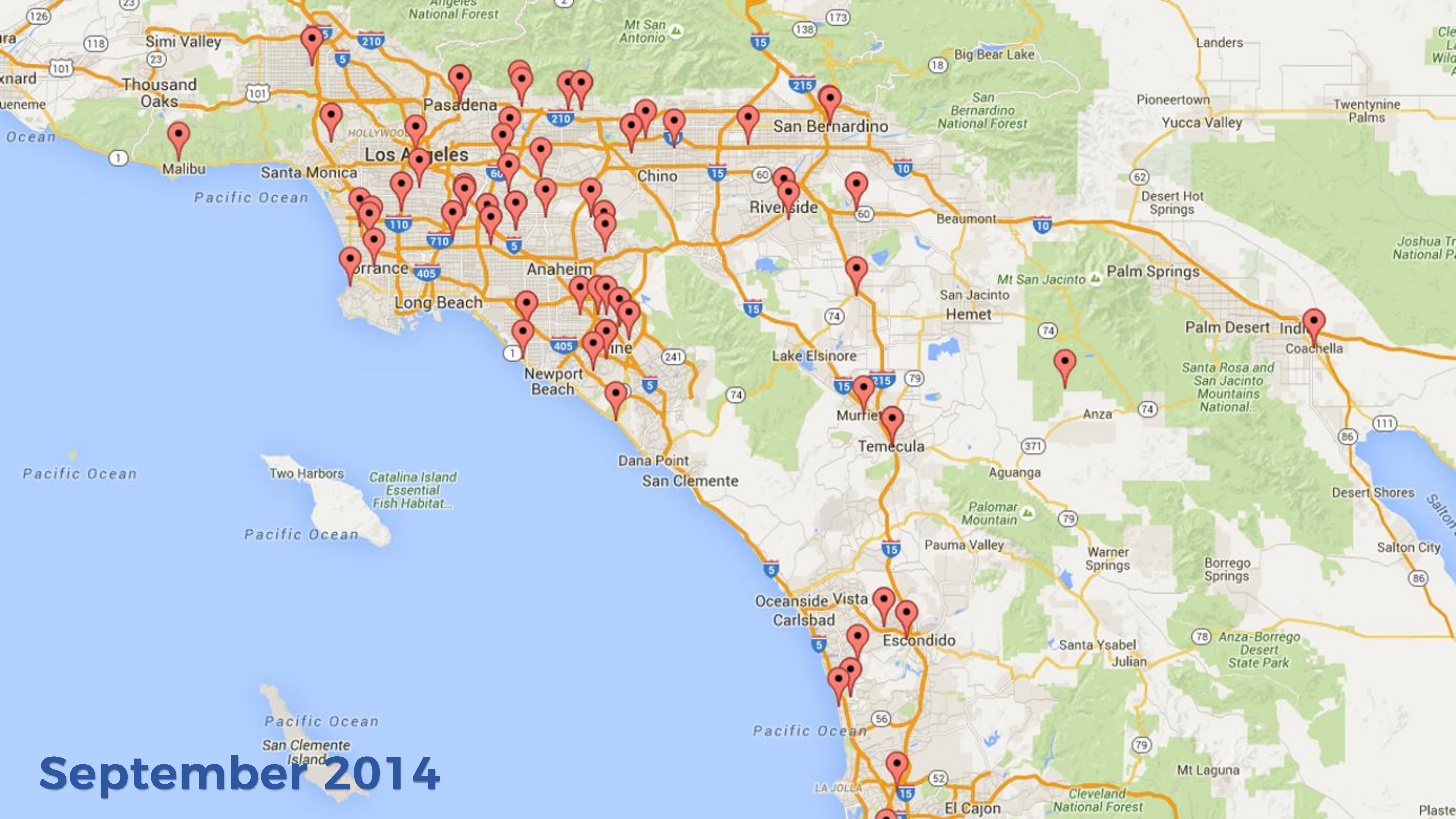
Cleveland National Forest

May 2014



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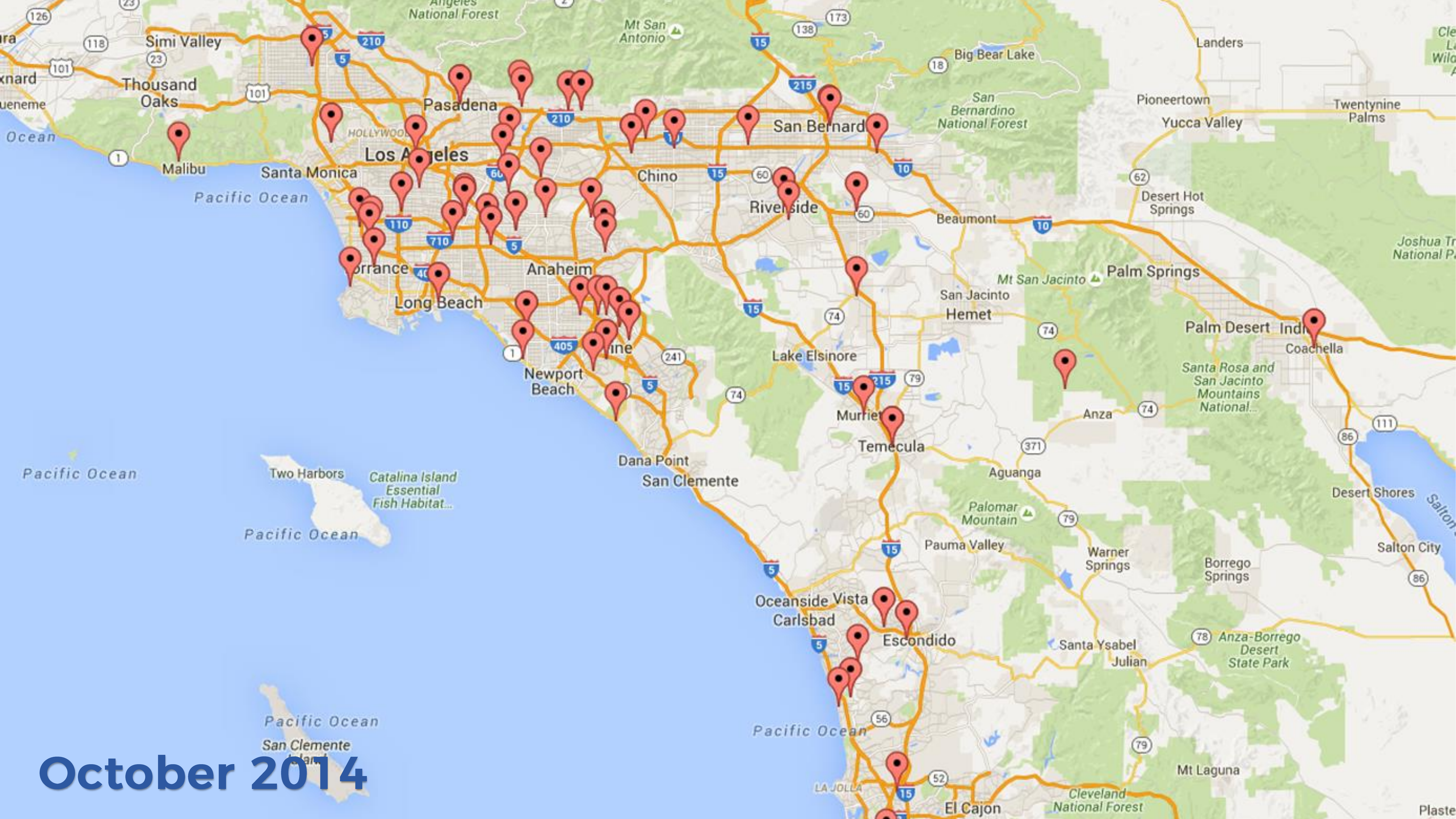

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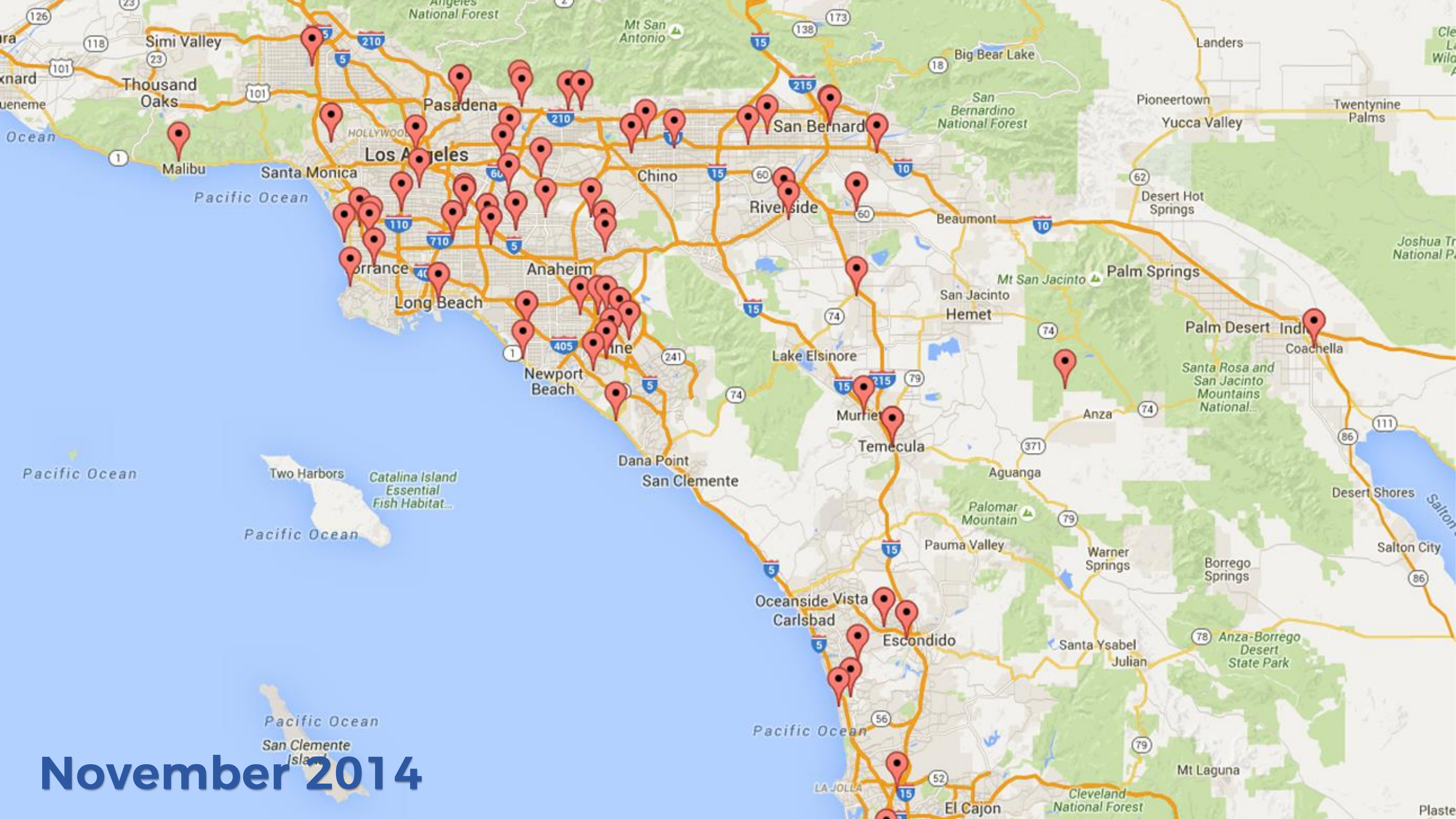

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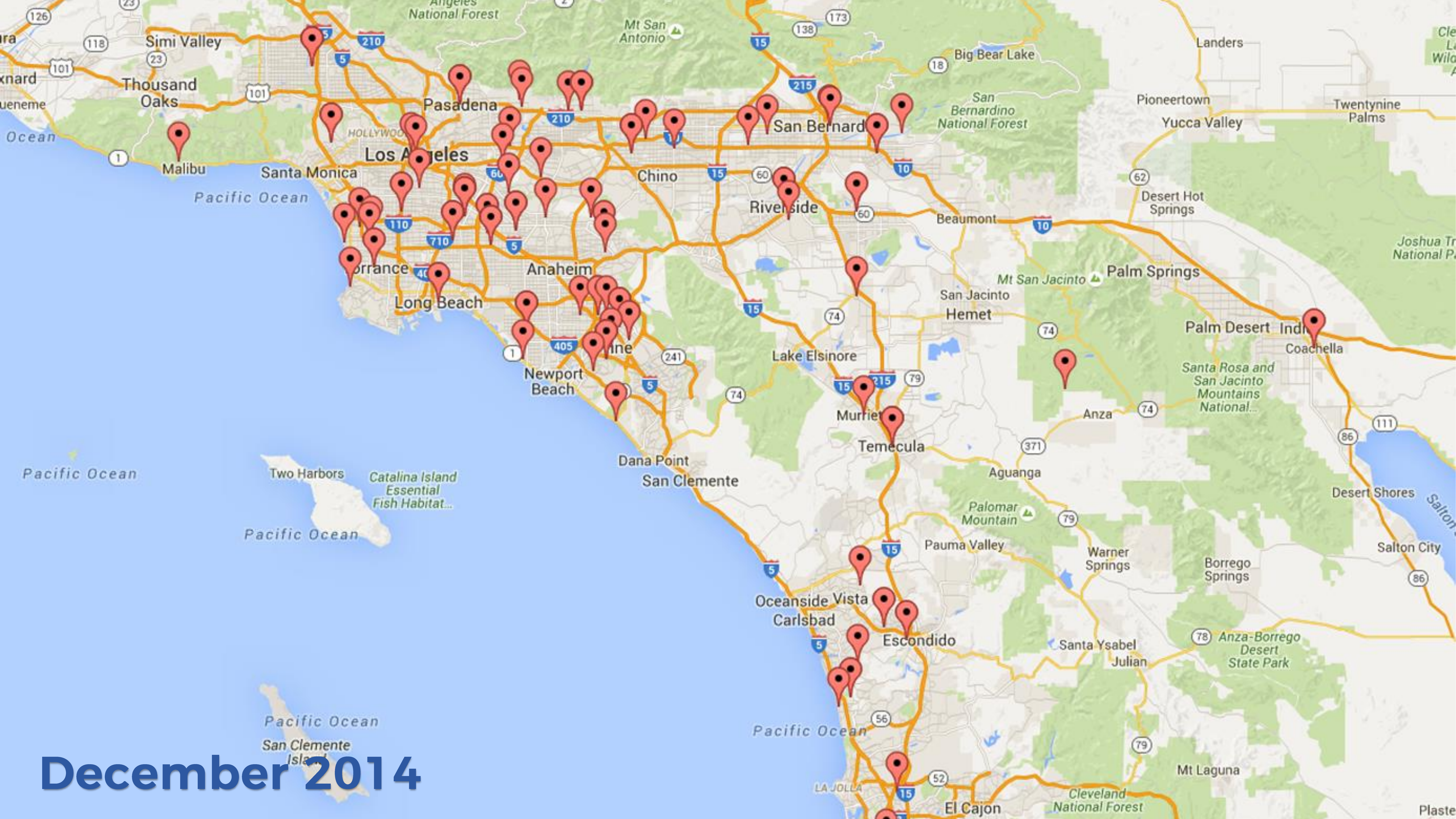

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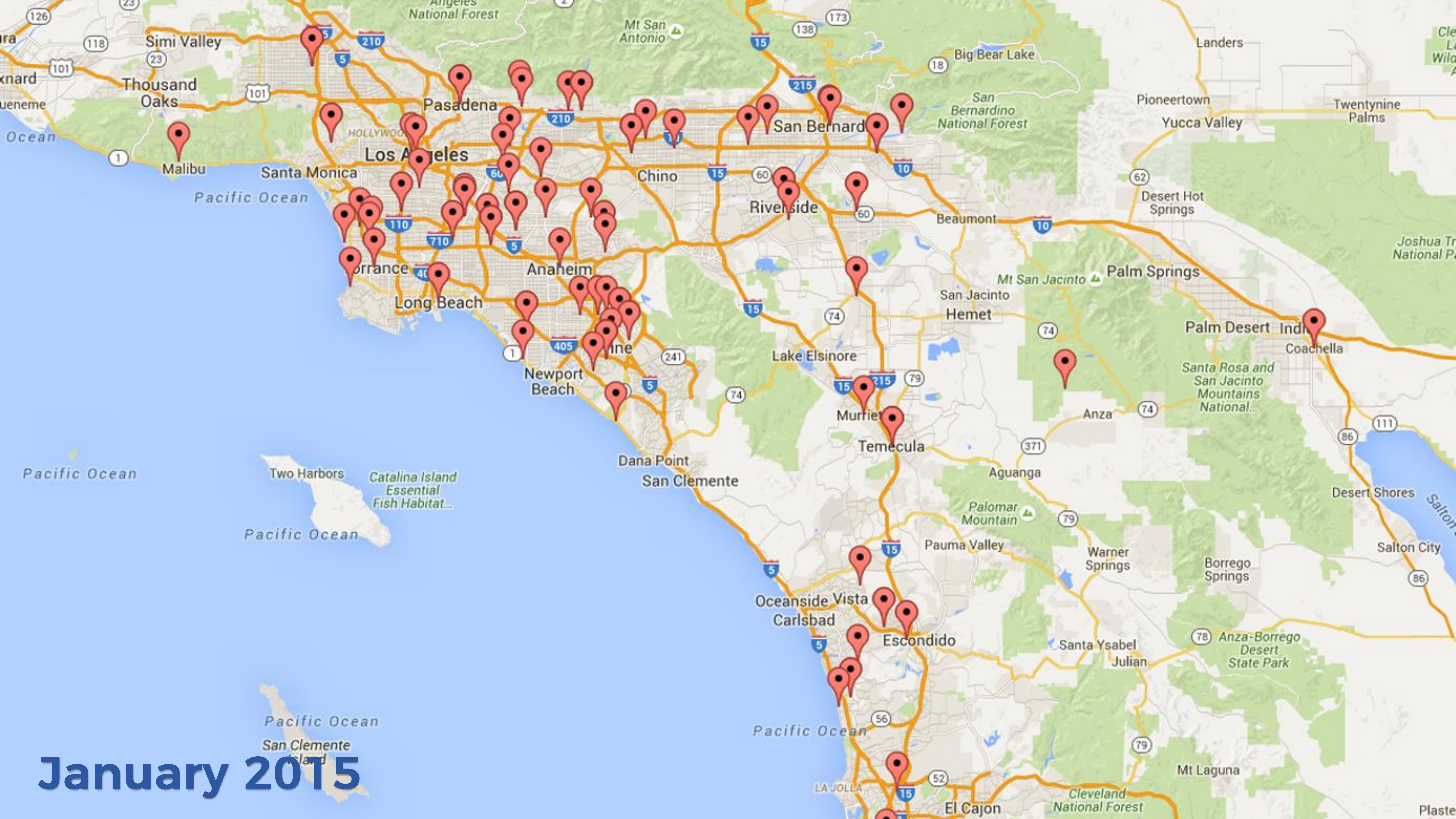

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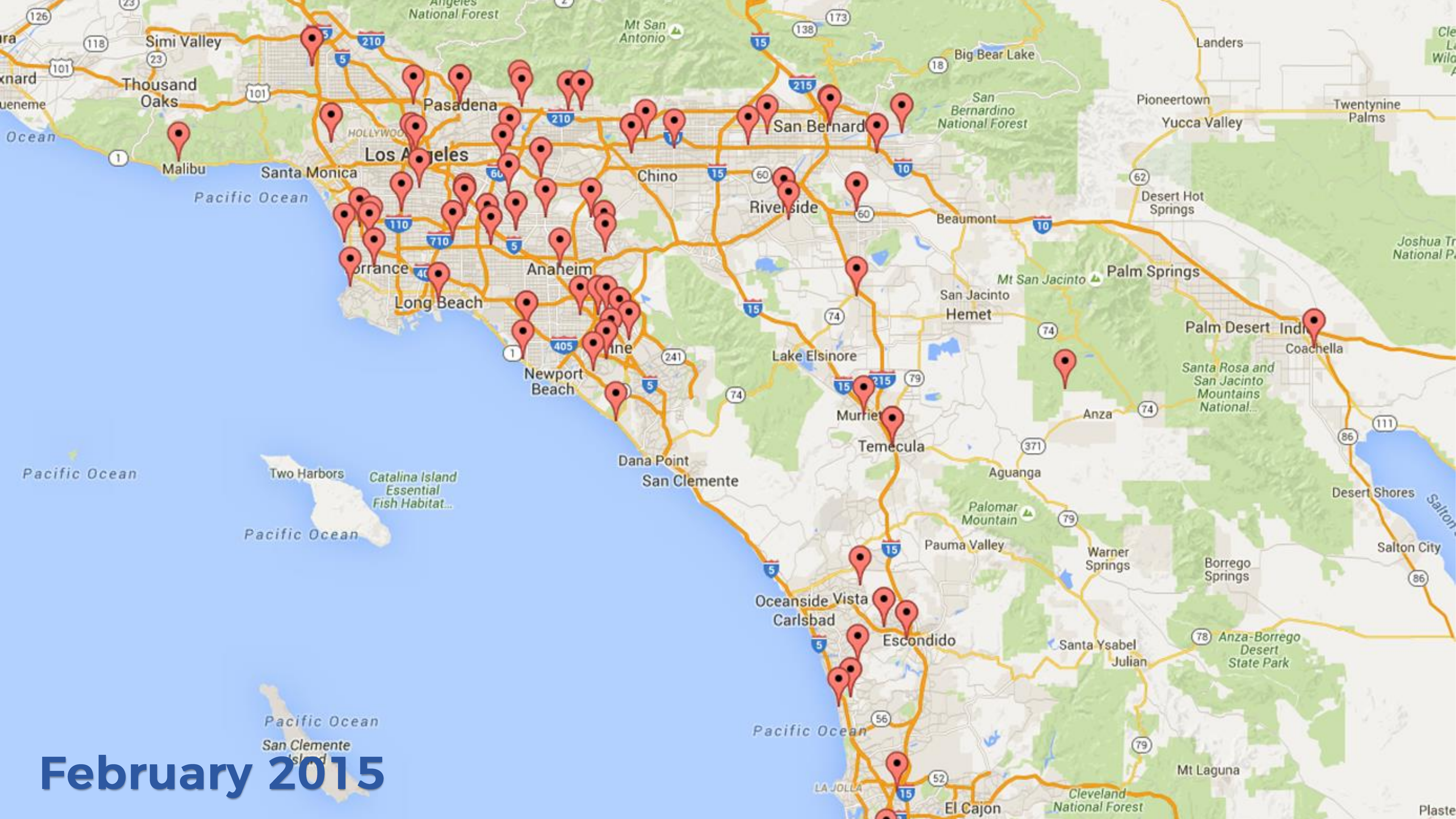

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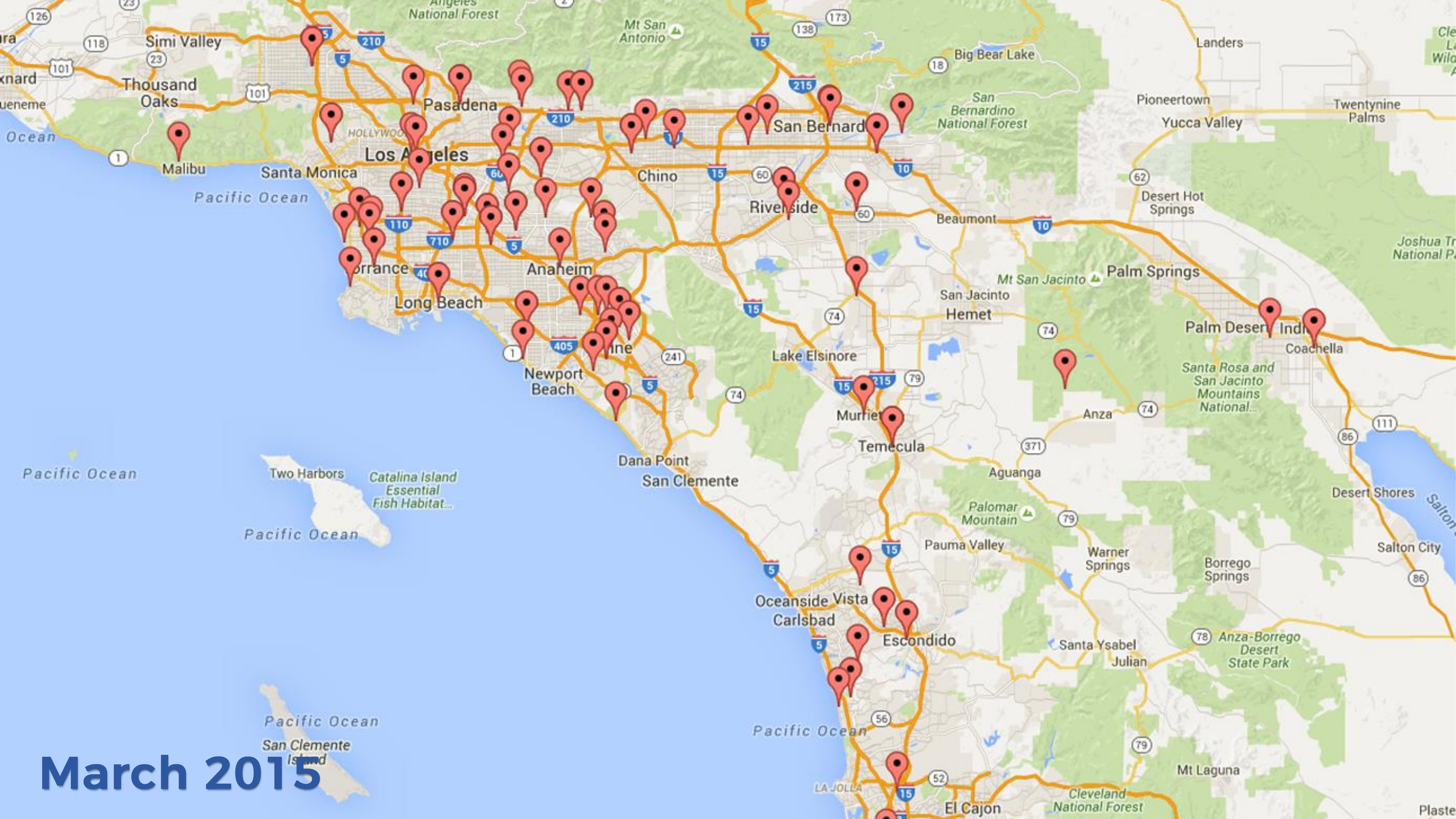
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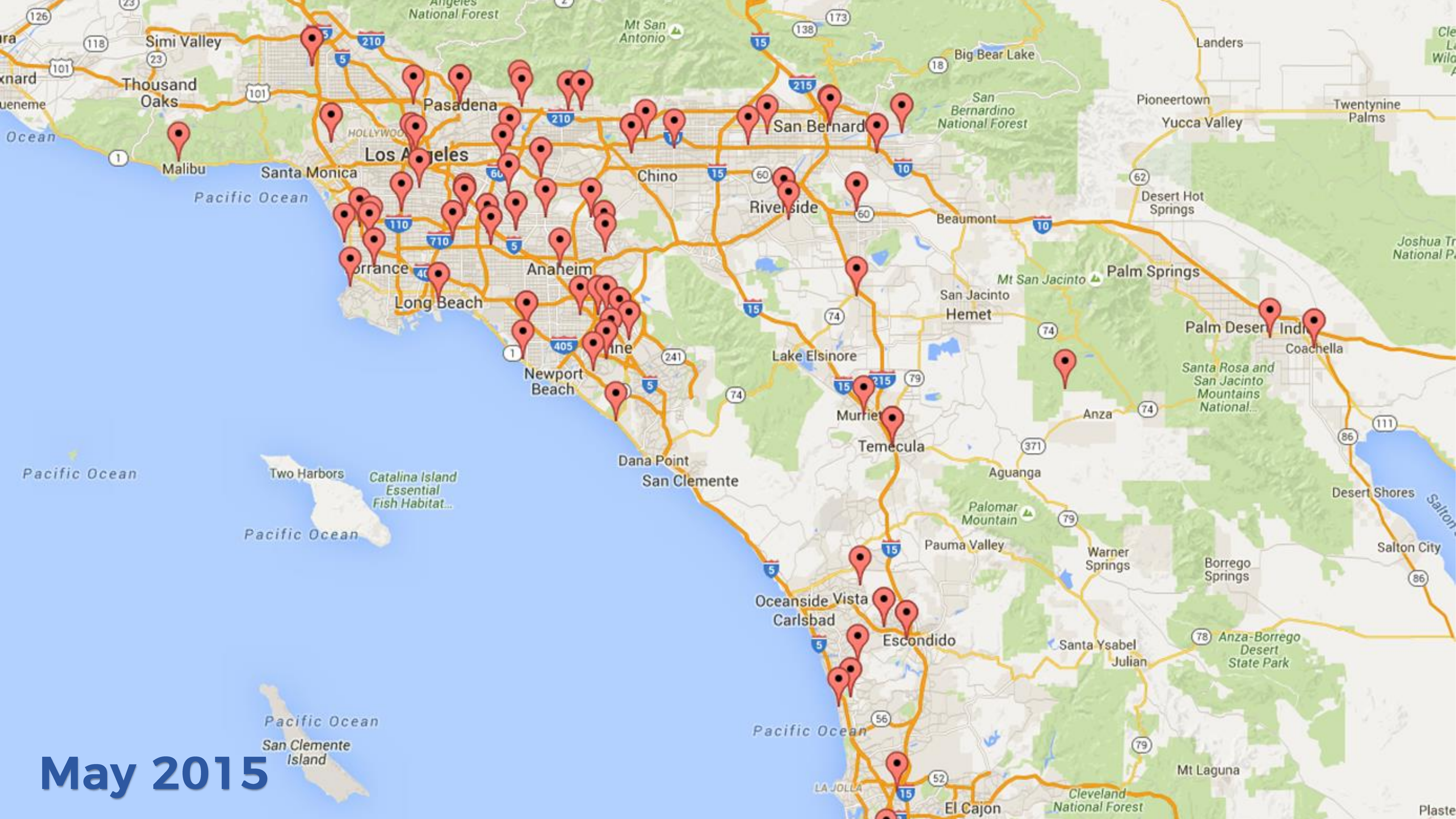
Plaster

March 2015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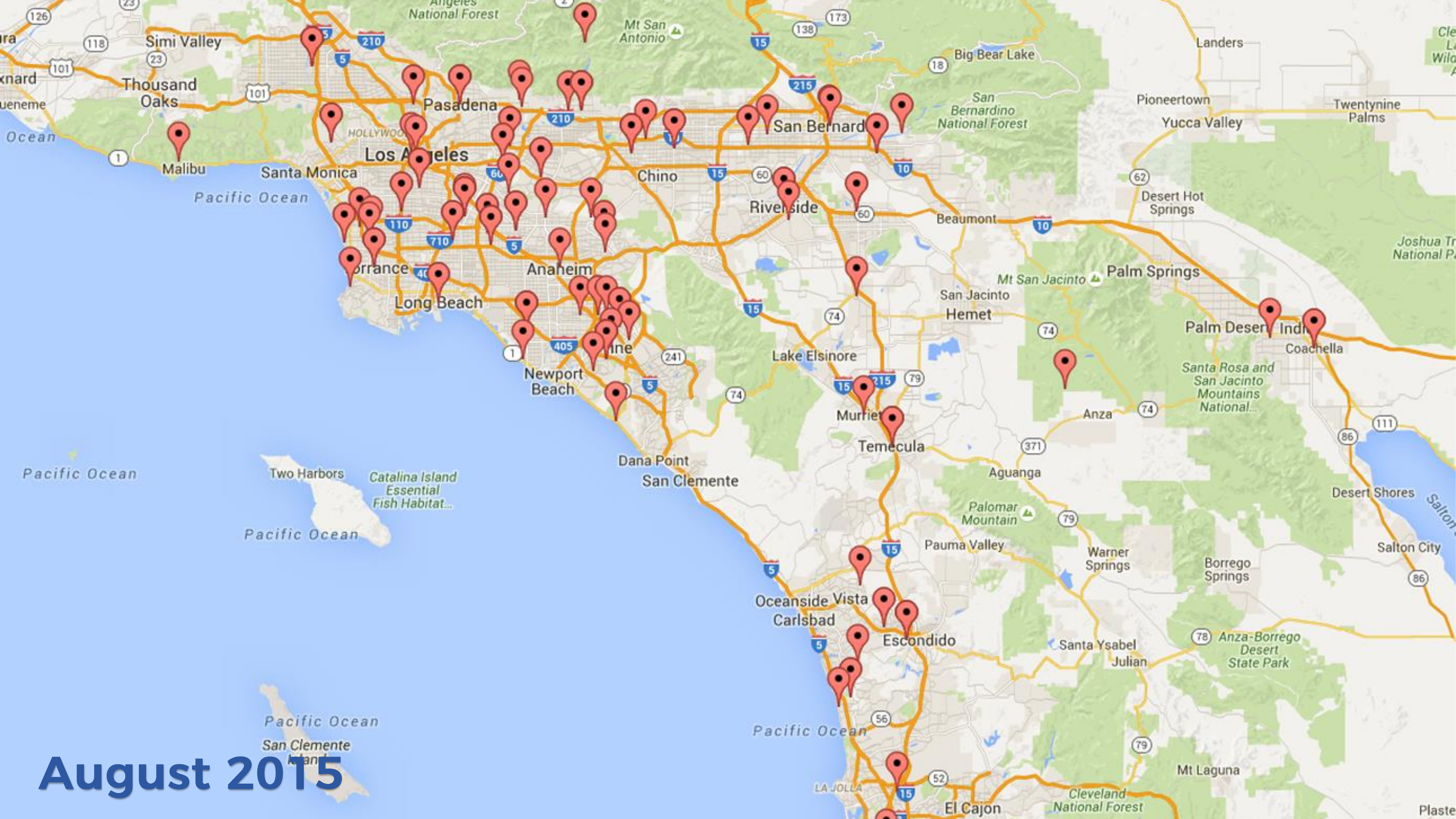
La Jolla
Mt San Antonio
Angeles National Forest

May 2015



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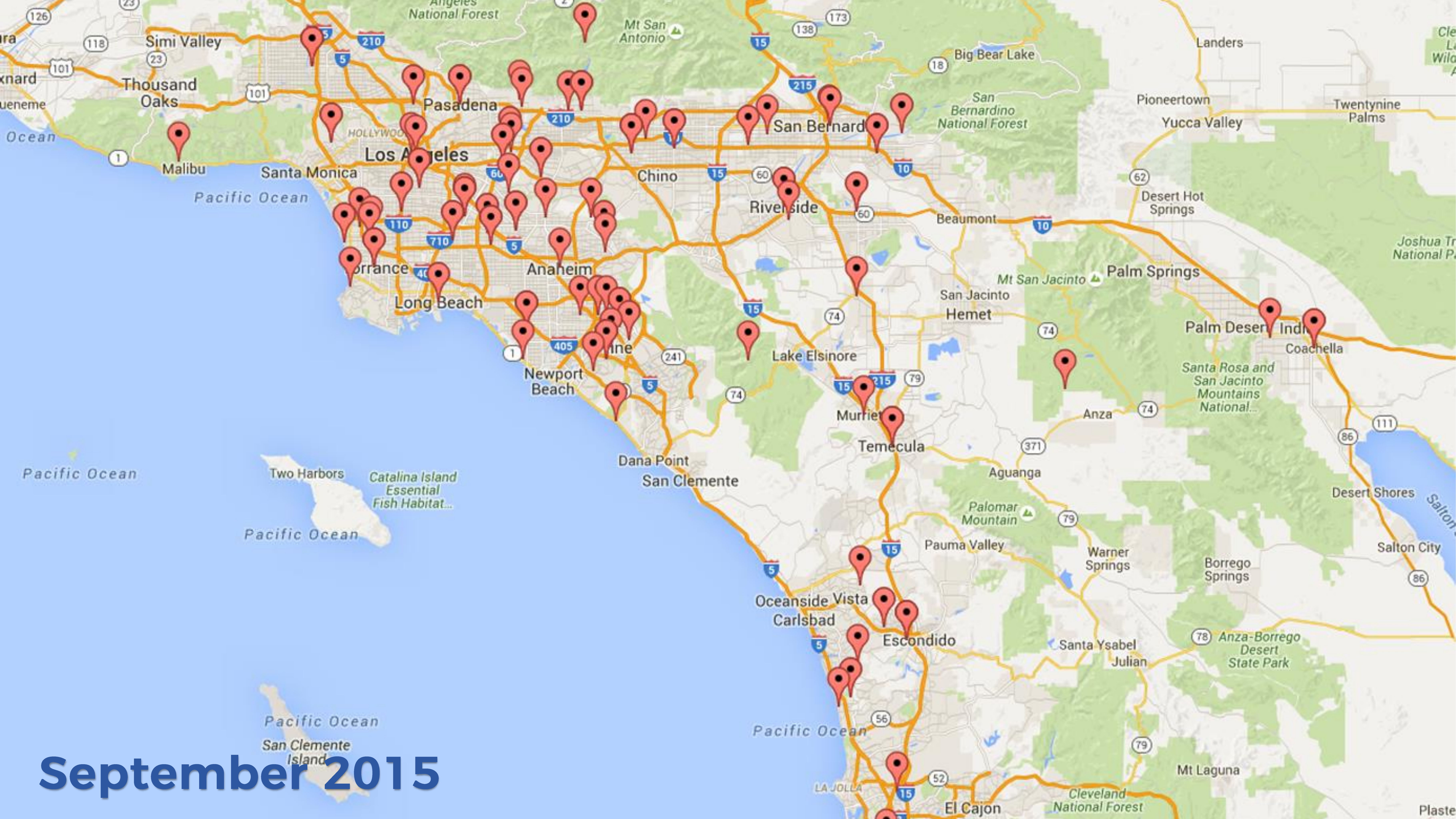
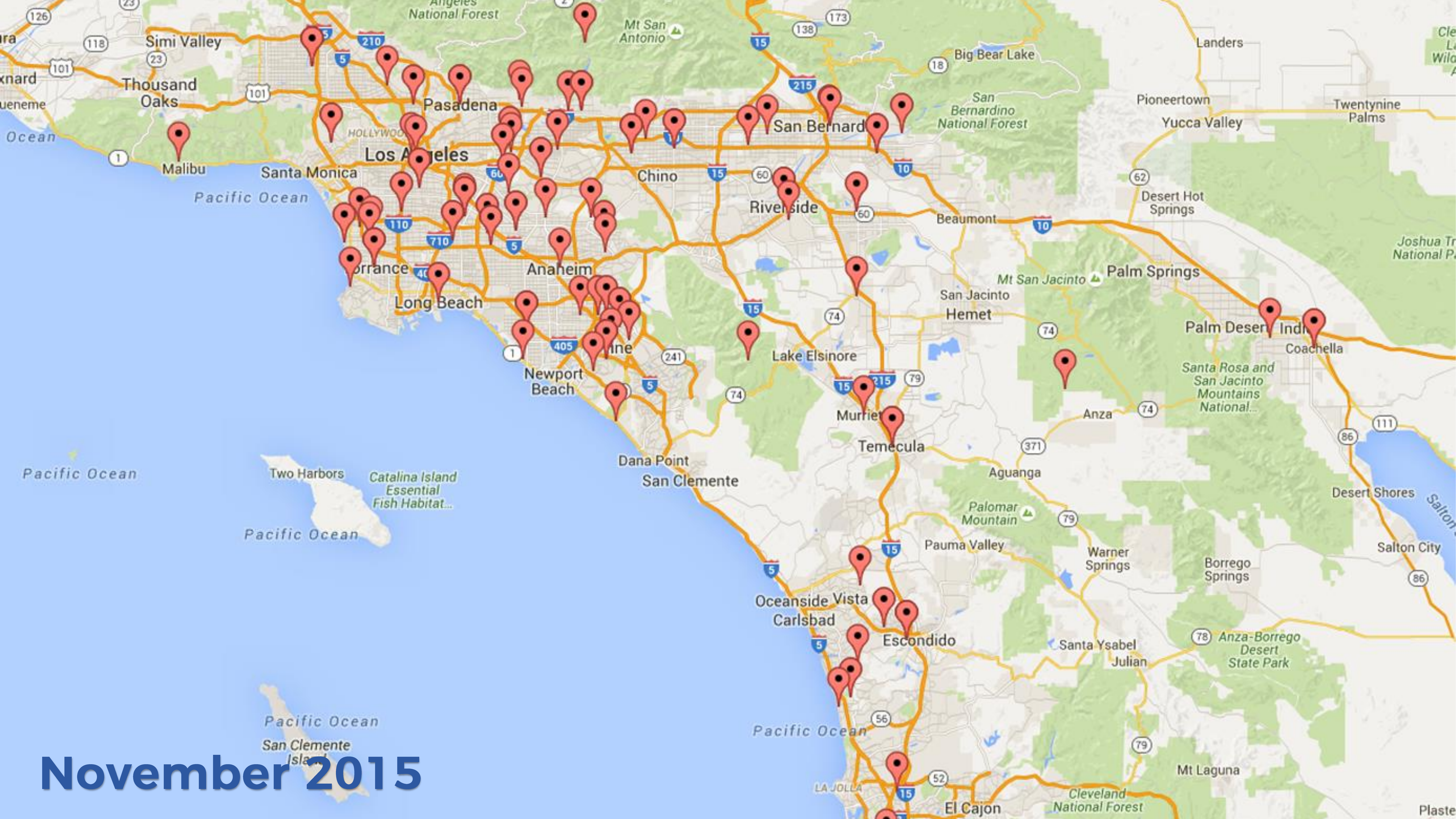
Dana Point
San Clemente
Two Harbors
Catalina Island Essential Fish Habitat...
Pacific Ocean
Palomar Mountain
Pauma Valley
Warner Springs
Borrego Springs
Desert Shores
Salton City
Oceanside
Vista
Carlsbad
Escondido
Santa Ysabel
Julian
Anza-Borrego Desert State Park
Pacific Ocean
San Clemente
LA JOLLA
Mt Laguna
El Cajon
Cleveland National Forest

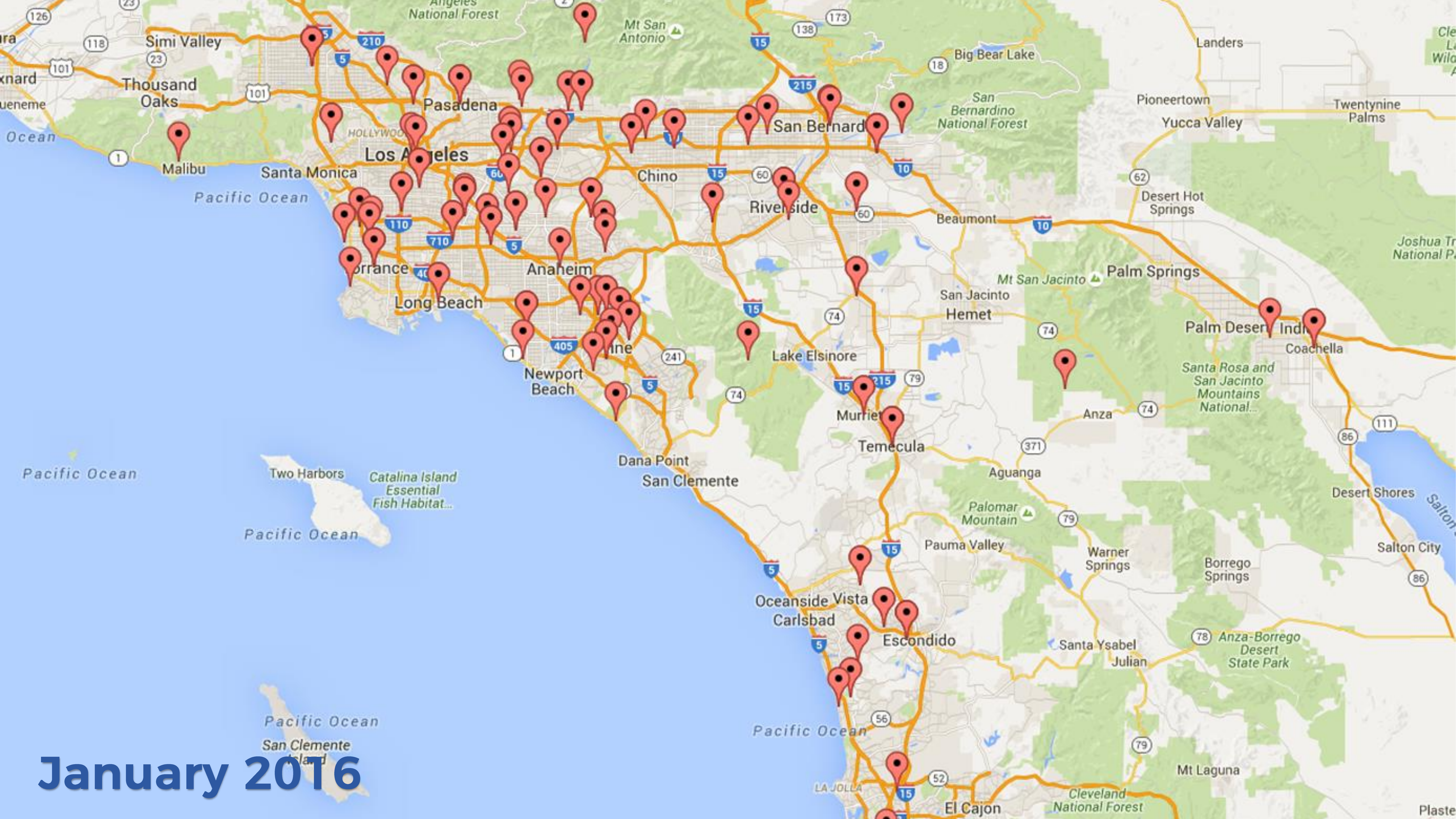
August 2015



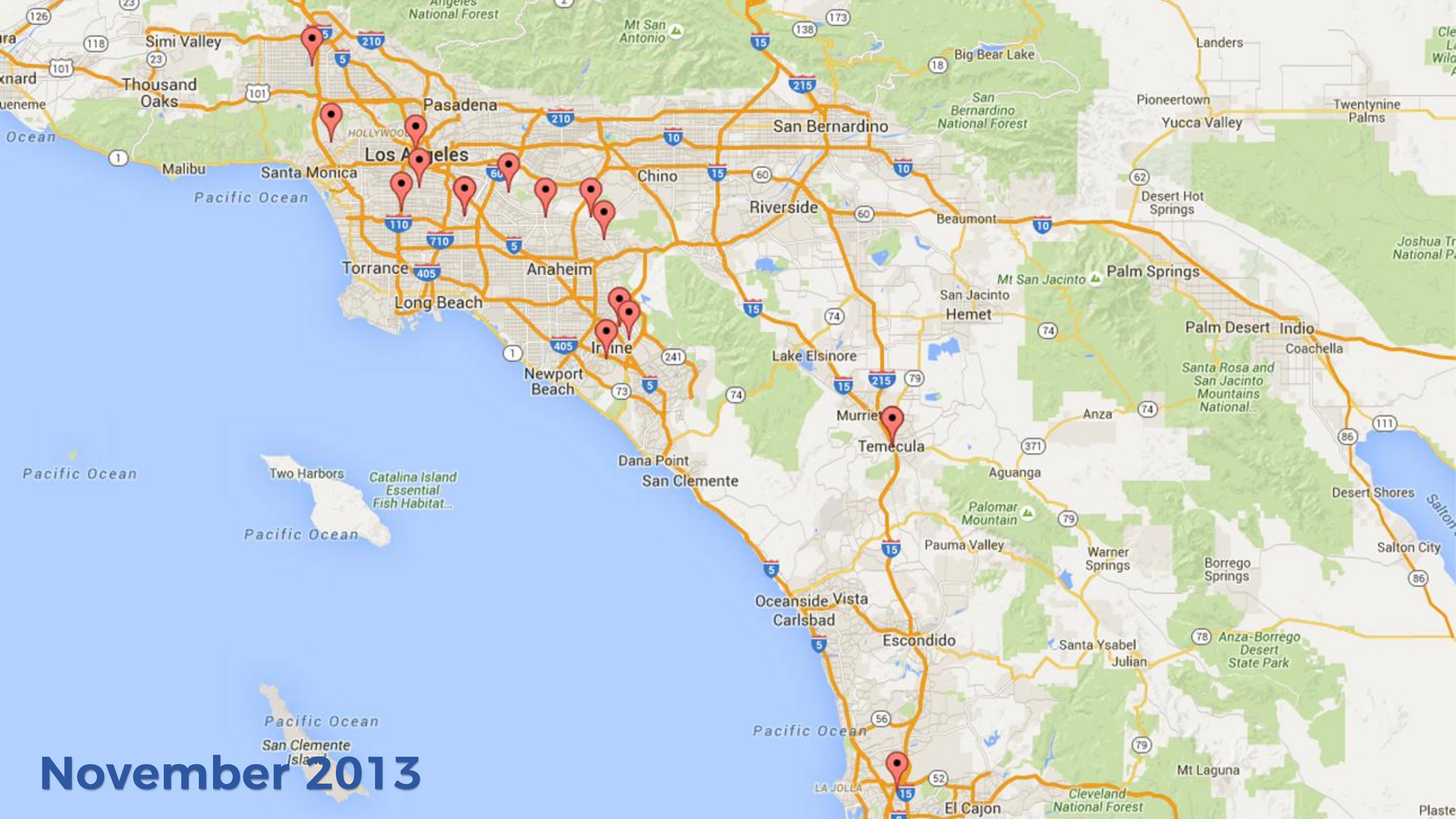
September 2015



November 2015



January 2016

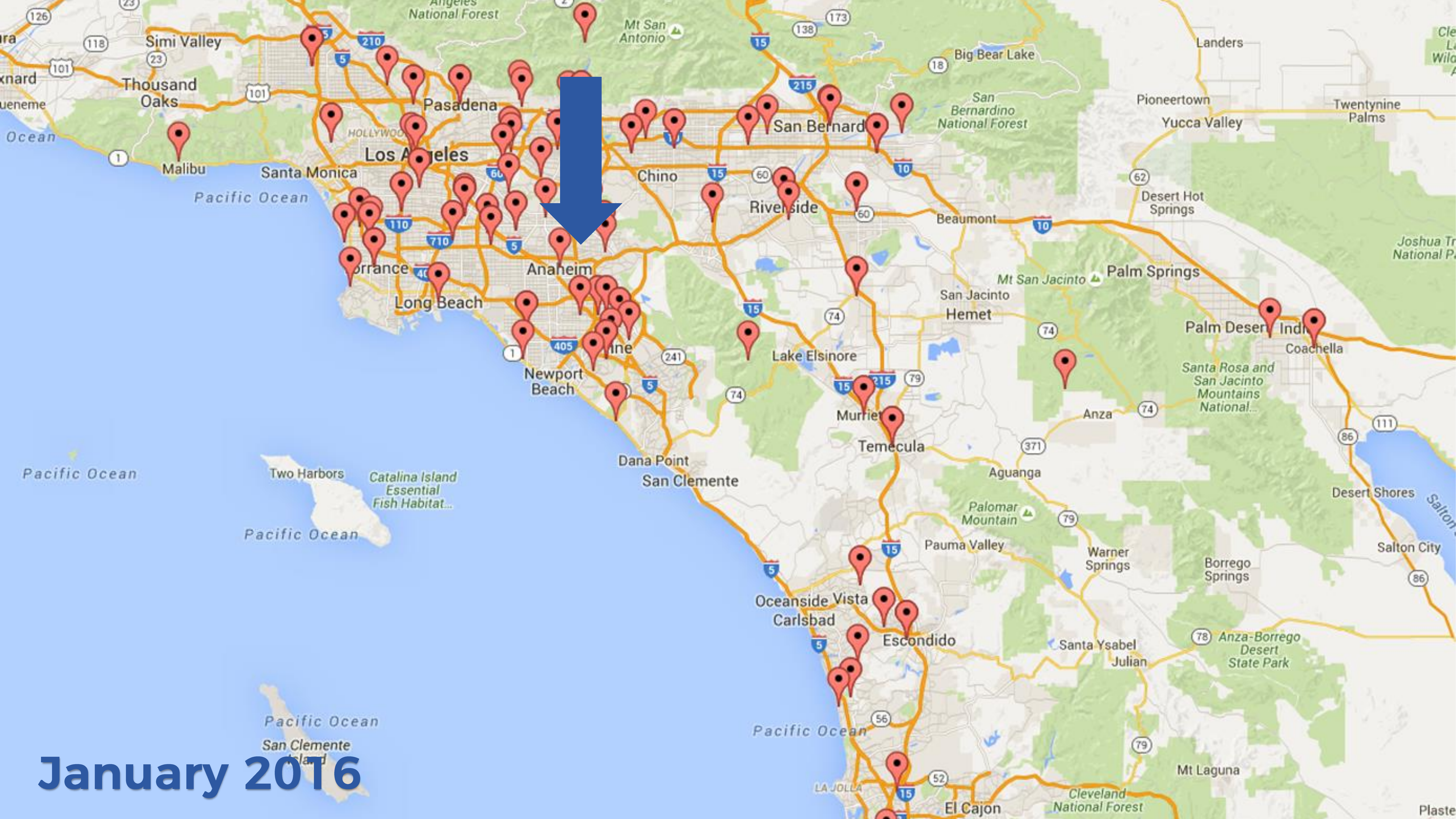


November 2013

Spies

Analysts

Model

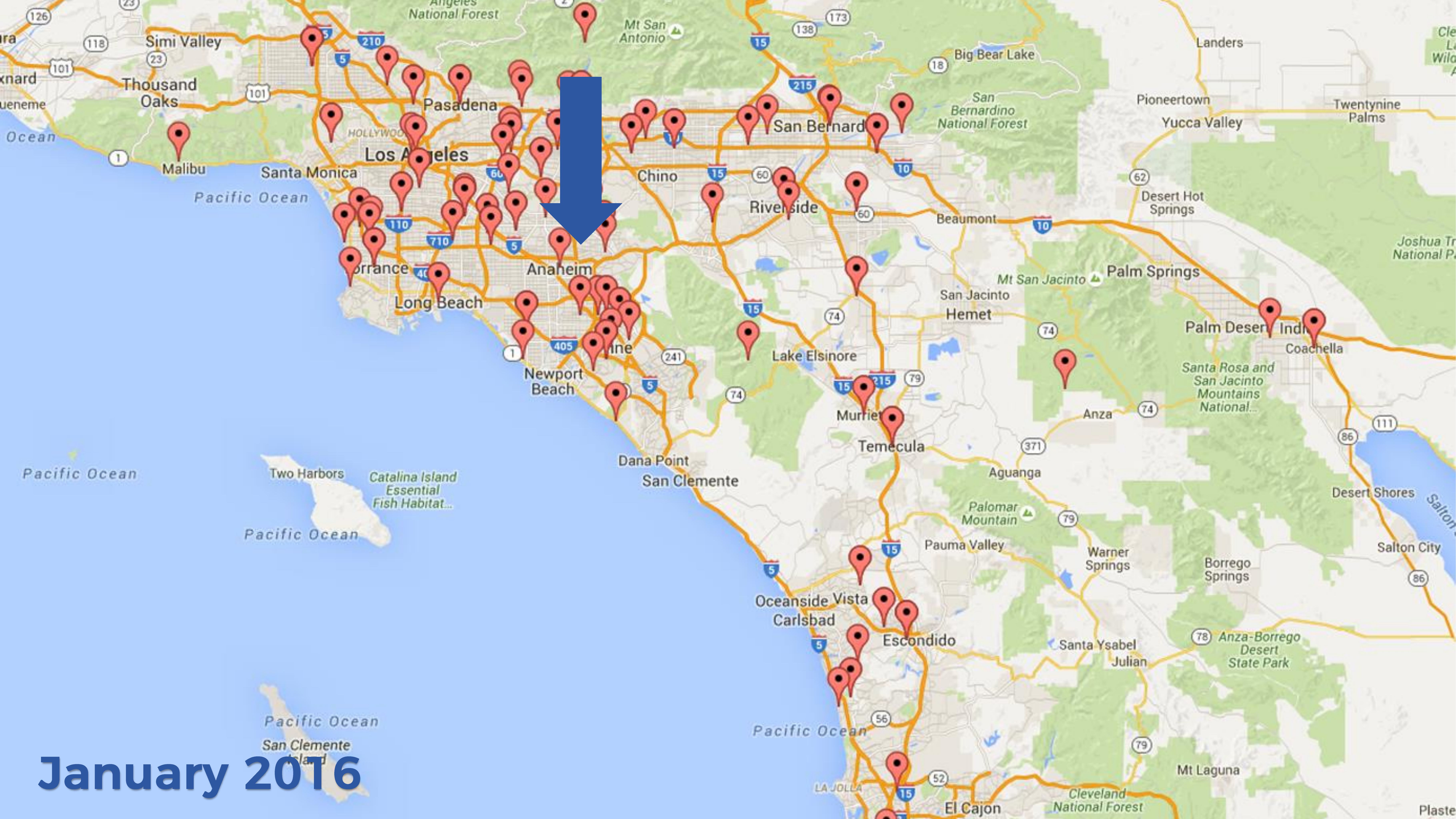


January 2016

Spies

Analysts

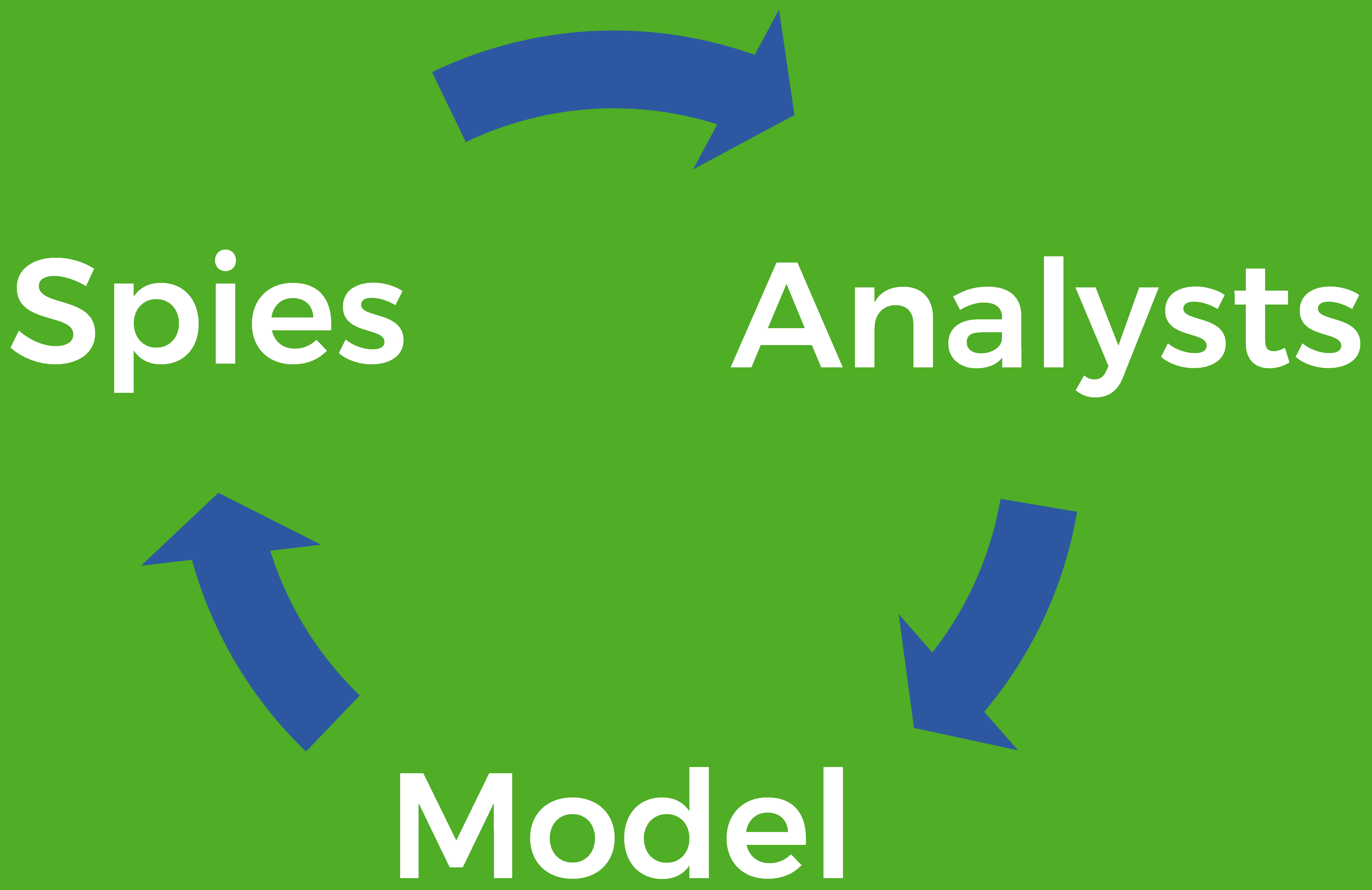
Model


January 2016

All models are wrong, but some are useful.

GEORGE E. P. BOX

Lay's
Classic
Doritos
NACHO CHEESE
Doritos
COOL RANCH
Cheetos
Crunchy
Sun Chips
ORIGINAL
Fritos
The ORIGINAL
4
4
2
4
2
4
Classic Mix
20 Singles
LAY'S® Classic Potato Chips, DORITOS® Nacho Cheese Flavored Tortilla Chips, DORITOS® COOL RANCH® Flavored Tortilla Chips, CHEETOS® Crunchy Cheese Flavored Snacks, SUNCHIPS® Original Multigrain Snacks, FRITOS® Original Corn Chips (All 1 OZ. Each)
20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g
⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.


Spies
Analysts
Model

THINKING TIME

Robert Kaplinsky
@robertkaplinsky

Hey #MTBoS, can you do me a favor and complete this 3 question anonymous survey about your favorite chips? I need data for a presentation. Please RT.
goo.gl/forms/etPtujlI… #iteachmath

Favorite Chips
Please complete this anonymous survey. I'll be using this data in a presentation.
docs.google.com

8:05 PM - 4 Feb 2018

63 Retweets **45** Likes

18 63 45

Favorite Chips (Responses)

File Edit View Insert Format Data Tools Form Add-ons Help

Comments Share

100% $ % .0 .00 123 Arial 10 B I S A

fx Timestamp

	A	B	C	D	E	F	G	H
1	Timestamp	Lays (Classic)	Doritos (Nacho Cheese)	Doritos (Cool Ranch)	Cheetos (Crunchy)	Sun Chips (Original)	Fritos (Original)	Time Zone
2	2/4/2018 20:06:53	6	5	4	2	3	1	Central Time Zone
3	2/4/2018 20:06:55	1	5	6	3	2	4	Eastern Time Zone
4	2/4/2018 20:06:56	5	2	1	3	6	4	Central Time Zone
5	2/4/2018 20:06:57	2	1	6	3	5	4	Pacific Time Zone
6	2/4/2018 20:07:36	4	1	2	3	5	6	Pacific Time Zone
7	2/4/2018 20:08:02	5	1	6	4	2	3	Pacific Time Zone
8	2/4/2018 20:08:05	6	2	4	3	5	1	Pacific Time Zone
9	2/4/2018 20:08:07	4	2	1	5	3	6	Pacific Time Zone
10	2/4/2018 20:08:29	5	3	4	1	6	2	Central Time Zone
11	2/4/2018 20:08:56	4	5	6	1	2	3	Central Time Zone
12	2/4/2018 20:09:54	5	6	5	6	5	4	Pacific Time Zone
13	2/4/2018 20:10:01	4	2	3	1	5	6	Pacific Time Zone
14	2/4/2018 20:10:04	6	2	3	1	5	4	Central Time Zone
15	2/4/2018 20:10:04	3	5	6	1	4	2	Central Time Zone
16	2/4/2018 20:10:05	4	2	6	1	3	5	Eastern Time Zone
17	2/4/2018 20:10:06	3	2	6	5	1	2	Pacific Time Zone
18	2/4/2018 20:10:10	4	2	6	3	5	1	Mountain Time Zone
19	2/4/2018 20:10:12	3	1	5	6	2	4	Eastern Time Zone
20	2/4/2018 20:10:26	5	3	6	2	4	1	Pacific Time Zone

Sheet3

Explore

THINKING TIME

- The available data includes:
  - Lays, Nacho Cheese Doritos, Cool Ranch Doritos, Cheetos, Sun Chips, and Fritos ranked from 1 to 6
  - Geographic region: West, Central, or Eastern

ANALYSTS' JOB FOR THE TOP 1

1. Count all the first place votes for each chip type.
2. Divide the total first place votes for each chip type by the total number of votes.
3. Multiply that fraction by 20 to find how many bags there would be in a twenty pack, rounding as necessary.

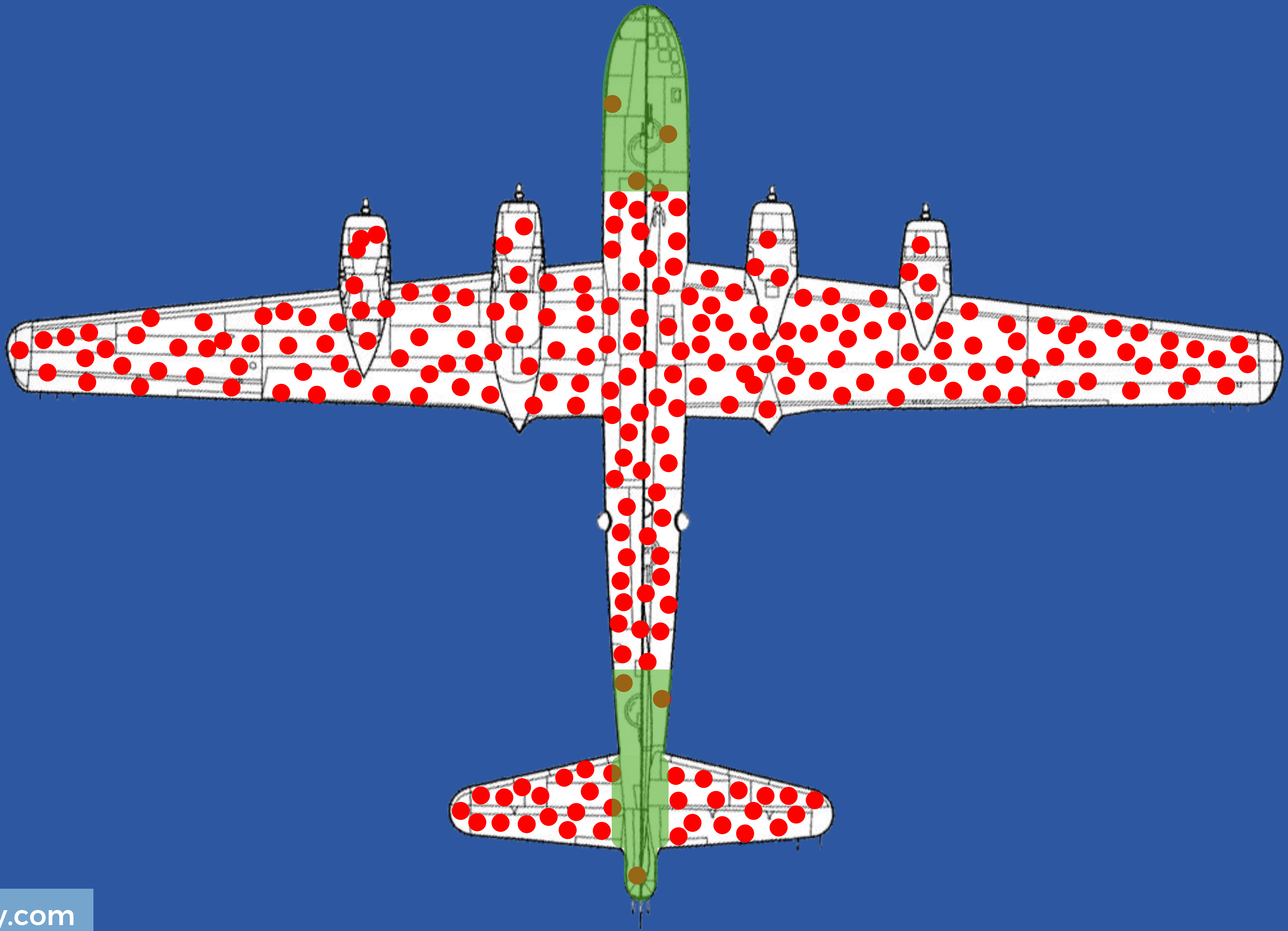
ANALYSTS' EXAMPLE

CHIP BAG RESULTS

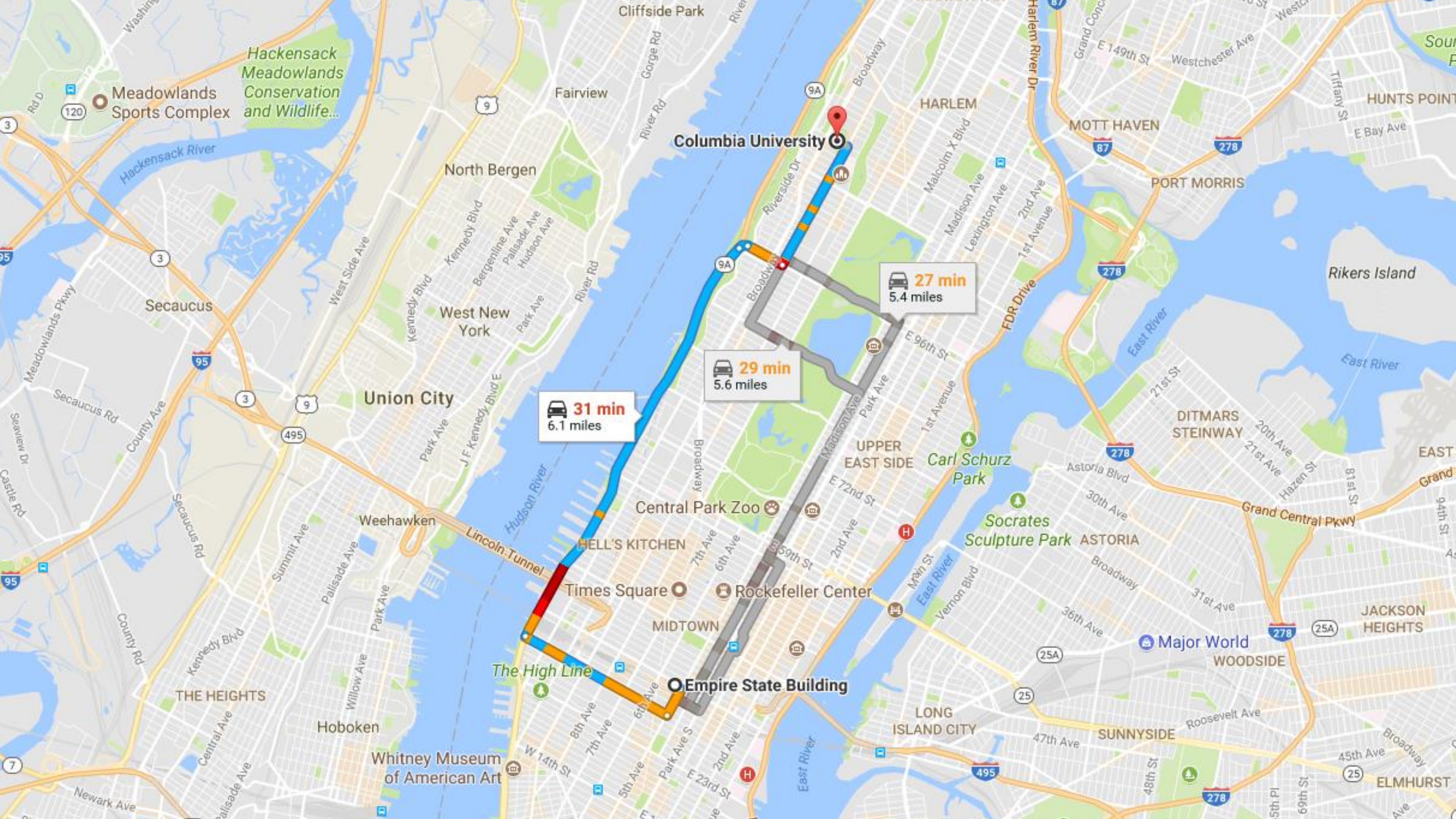
MATH MODELING

- [x] HOW DO WE MAKE SENSE OF MATH MODELING?
- [ ] IS IT JUST ANSWERING QUESTIONS?
- [ ] HOW IS MATH MODELING USED IN REAL LIFE?
- [ ] HOW DO WE HELP OUR STUDENTS IMPROVE?


224612



- ~~How do we protect our planes?~~
- ~~Which parts of the plane are being hit by the most bullets?~~
- Which parts of the plane are the most critical to protect?



Columbia University
Empire State Building
31 min
6.1 miles
29 min
5.6 miles
27 min
5.4 miles
Cliffside Park
Meadowlands Sports Complex
Hackensack Meadowlands Conservation and Wildlife...
Hackensack River
Fairview
North Bergen
Secaucus
West New York
Union City
Weehawken
Lincoln Tunnel
Hoboken
THE HEIGHTS
Whitney Museum of American Art
The High Line
HELL'S KITCHEN
Times Square
Rockefeller Center
MIDTOWN
Central Park Zoo
UPPER EAST SIDE
Carl Schurz Park
Socrates Sculpture Park
ASTORIA
HARLEM
MOTT HAVEN
HUNTS POINT
PORT MORRIS
Rikers Island
East River
Hudson River
DITMARS STEINWAY
JACKSON HEIGHTS
Major World
WOODSIDE
LONG ISLAND CITY
SUNNYSIDE
ELMHURST
Grand Central Pkwy
FDR Drive
Harlem River Dr
Broadway
Riverside Dr
E 96th St
E 72nd St
59th St
W 14th St
E 23rd St

- ~~How do we find the fastest route for each customer?~~
- How do we find the fastest route for each customer without impacting our other customers?


Lay's
Classic
Doritos
NACHO CHEESE
Doritos
COOL RANCH
Cheetos
Crunchy
Sun Chips
ORIGINAL
Fritos
BRAND
The ORIGINAL
CORN CHIPS
4
4
2
4
2
4
Classic Mix
20
Singles
4 LAY'S® Classic Potato Chips, 4 DORITOS® Nacho Cheese Flavored Tortilla Chips, 2 DORITOS® COOL RANCH® Flavored Tortilla Chips, 4 CHEETOS® Crunchy Cheese Flavored Snacks, 2 SUNCHIPS® Original Multigrain Snacks, 4 FRITOS® Original Corn Chips (All 1 OZ. Each)
20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g
WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

- ~~How many of each flavor should we put in a package?~~
- ~~How many of each flavor should we put in a package for each region?~~
- How can we determine if the extra cost of creating different packages will make us more money?

Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later.

CCSS MATH PRACTICE 4

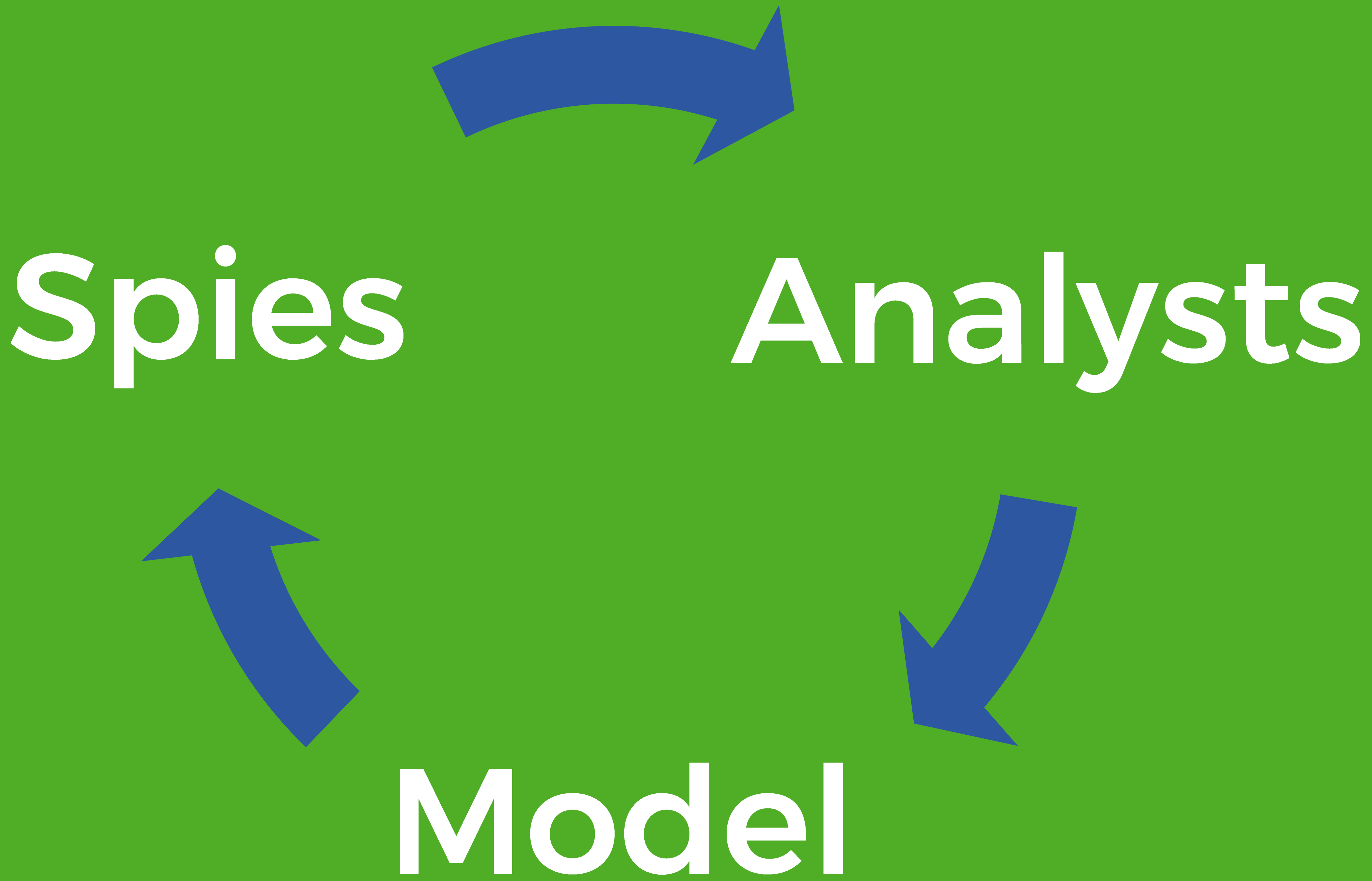
They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

CCSS MATH PRACTICE 4

MATH MODELING

- [x] HOW DO WE MAKE SENSE OF MATH MODELING?
- [x] IS IT JUST ANSWERING QUESTIONS?
- [ ] HOW IS MATH MODELING USED IN REAL LIFE?
- [ ] HOW DO WE HELP OUR STUDENTS IMPROVE?


TARGET
TARGET PARKING

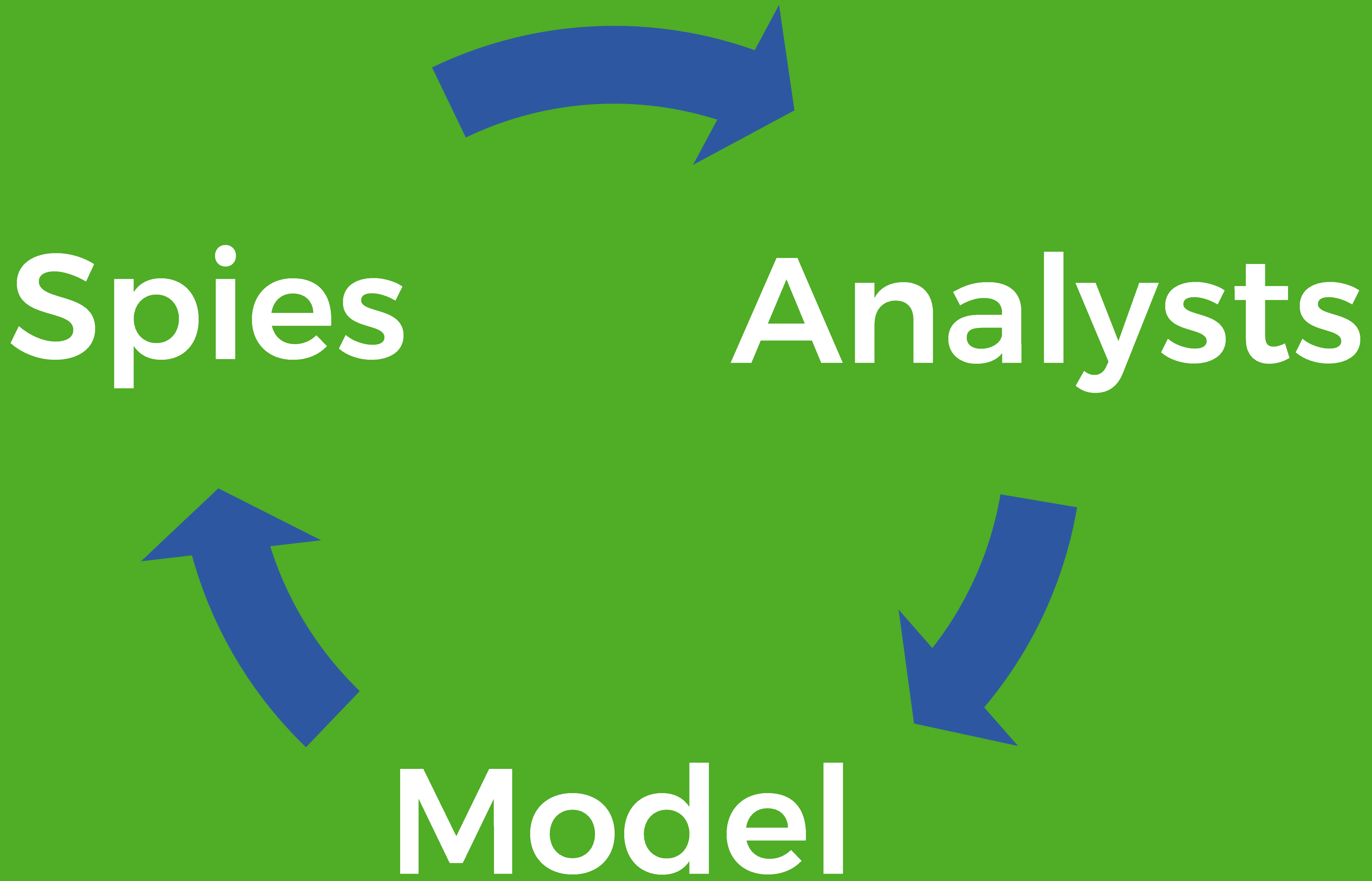

Spies
Analysts
Model

They used 25 products for a pregnancy prediction’ score including:

- unscented lotion
- mineral supplements
- cotton balls

Source: New York Times

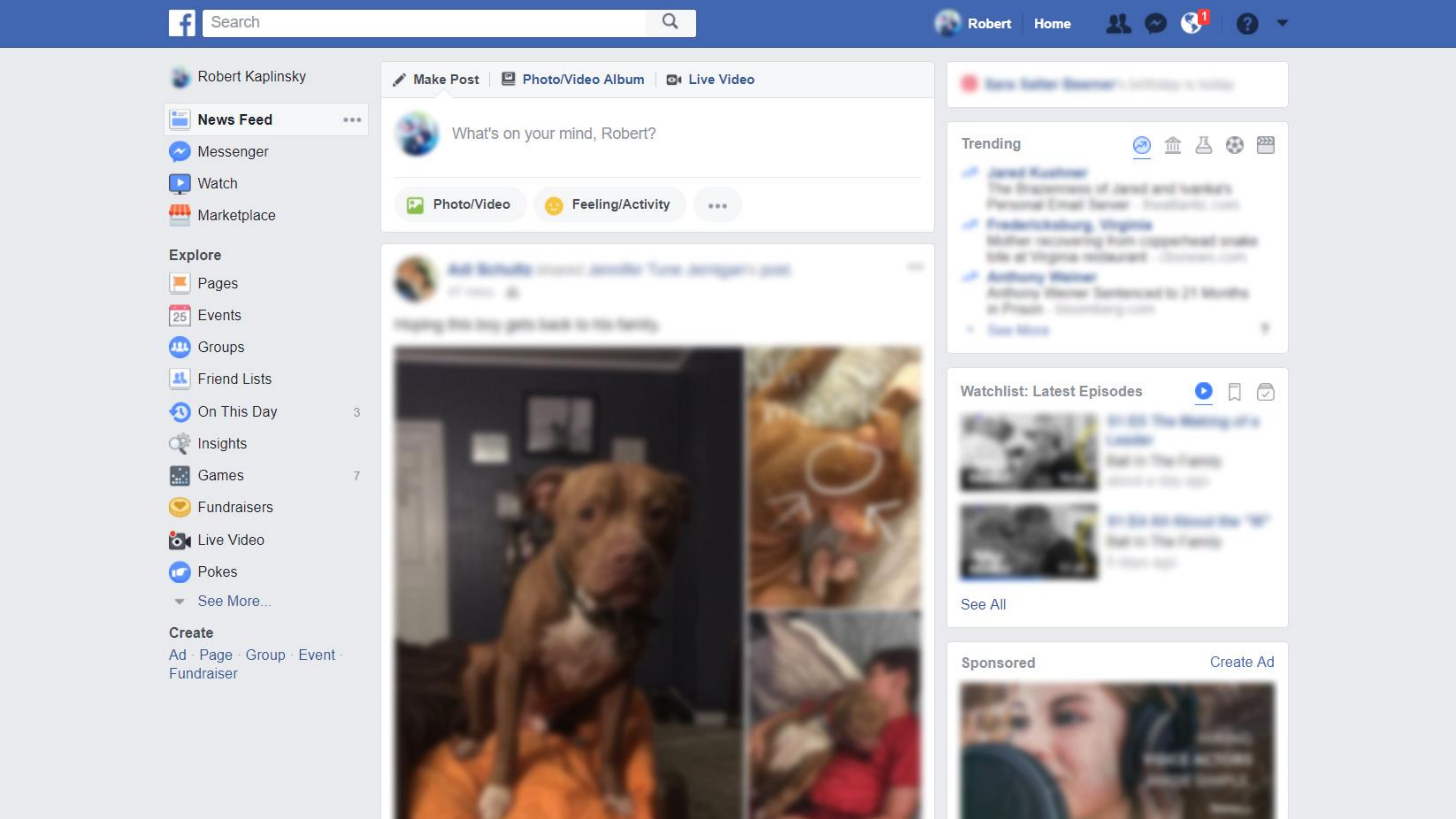

UNITED
A319
4047
B G→

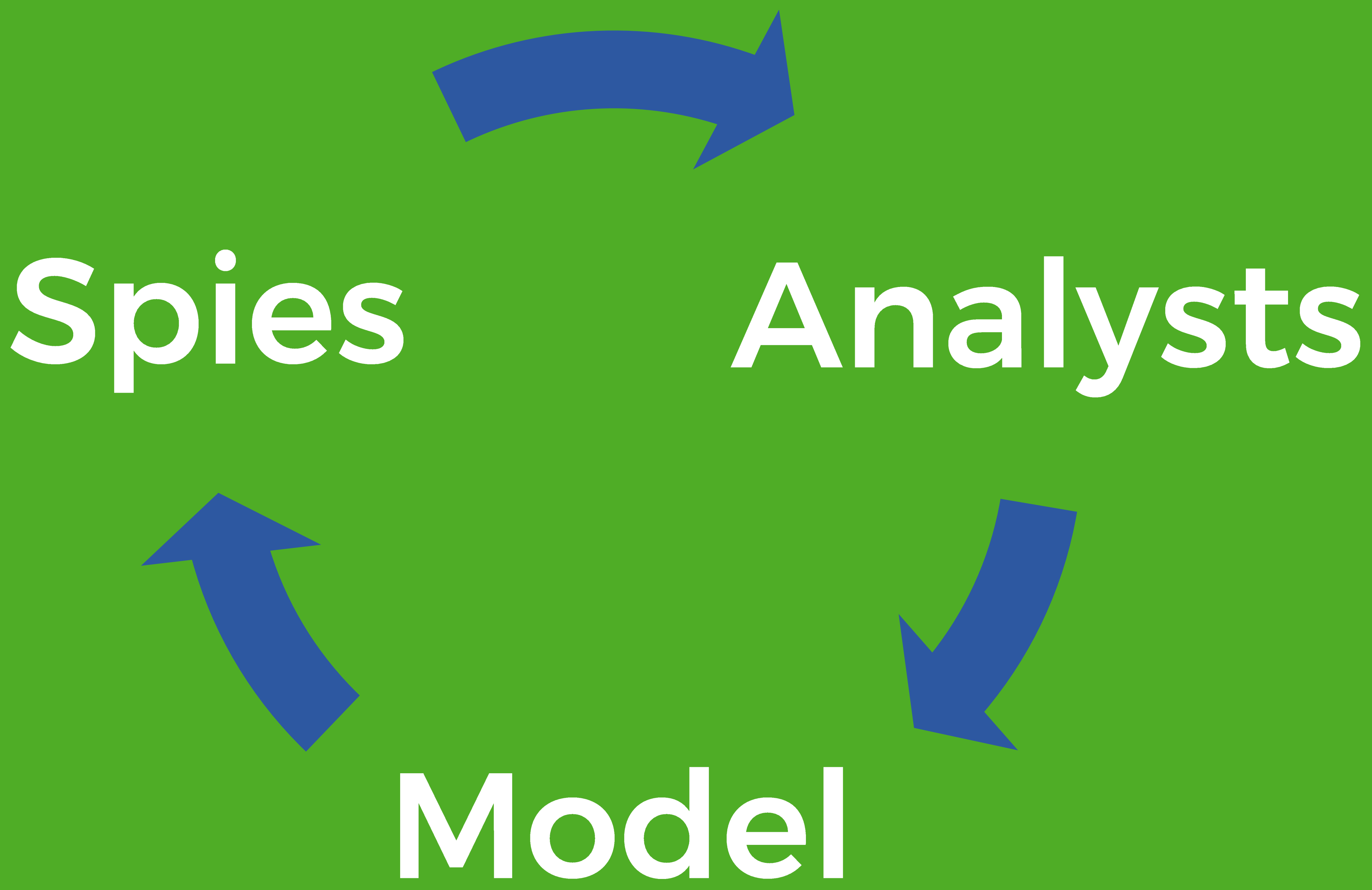

Spies
Analysts
Model

Priority is determined by:

- passenger’s fare class
- itinerary
- frequent flyer program membership
- check-in time

Source: United Airlines


Search
Robert
Home
1
Robert Kaplinsky
News Feed
Messenger
Watch
Marketplace
Explore
Pages
25
Events
Groups
Friend Lists
On This Day
3
Insights
Games
7
Fundraisers
Live Video
Pokes
See More...
Create
Ad · Page · Group · Event ·
Fundraiser
Make Post
Photo/Video Album
Live Video
What's on your mind, Robert?
Photo/Video
Feeling/Activity
Trending
Watchlist: Latest Episodes
See All
Sponsored
Create Ad


Spies
Analysts
Model

The stories that show in your News Feed are influenced by:

- friends you interact with the most
- the number of comments and likes a post receives
- what kind of story it is (ex: photo, video, status update)

Source: Facebook

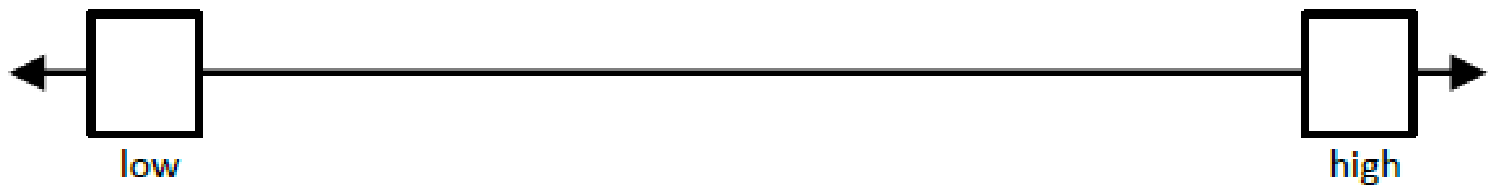
MORE EXAMPLES

- How does US News and World Reports rank colleges?
- How does Google know which results to show?
- How do sports teams know who to draft?
- How does Amazon know what products to recommend?
- How does Zillow estimate home prices?
- How does Pandora know what music to play?
- How does eHarmony know which people to show you?
- How do they figure out who should speak at a conference?

MATH MODELING

- ☑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ☑ IS IT JUST ANSWERING QUESTIONS?
- ☑ HOW IS MATH MODELING USED IN REAL LIFE?
- ☐ HOW DO WE HELP OUR STUDENTS IMPROVE?

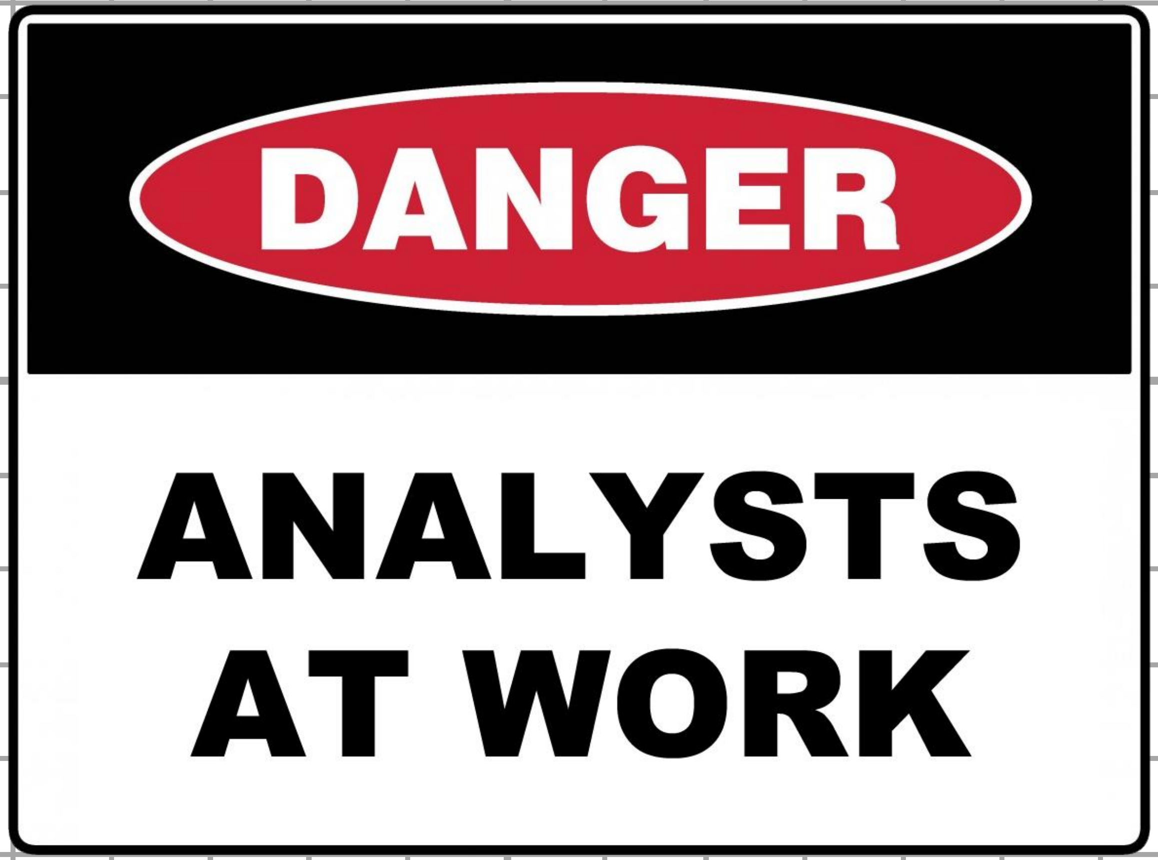
Name: ______________________________ Period: ________ Date: __________________

What problem are you trying to figure out?	What estimates do you have?
	 Place your estimate on the number line.
What info do you already know about the problem?	**What info do you need about the problem?**

TOP SECRET! SPIES ONLY

What is your conclusion? How did you reach that conclusion?

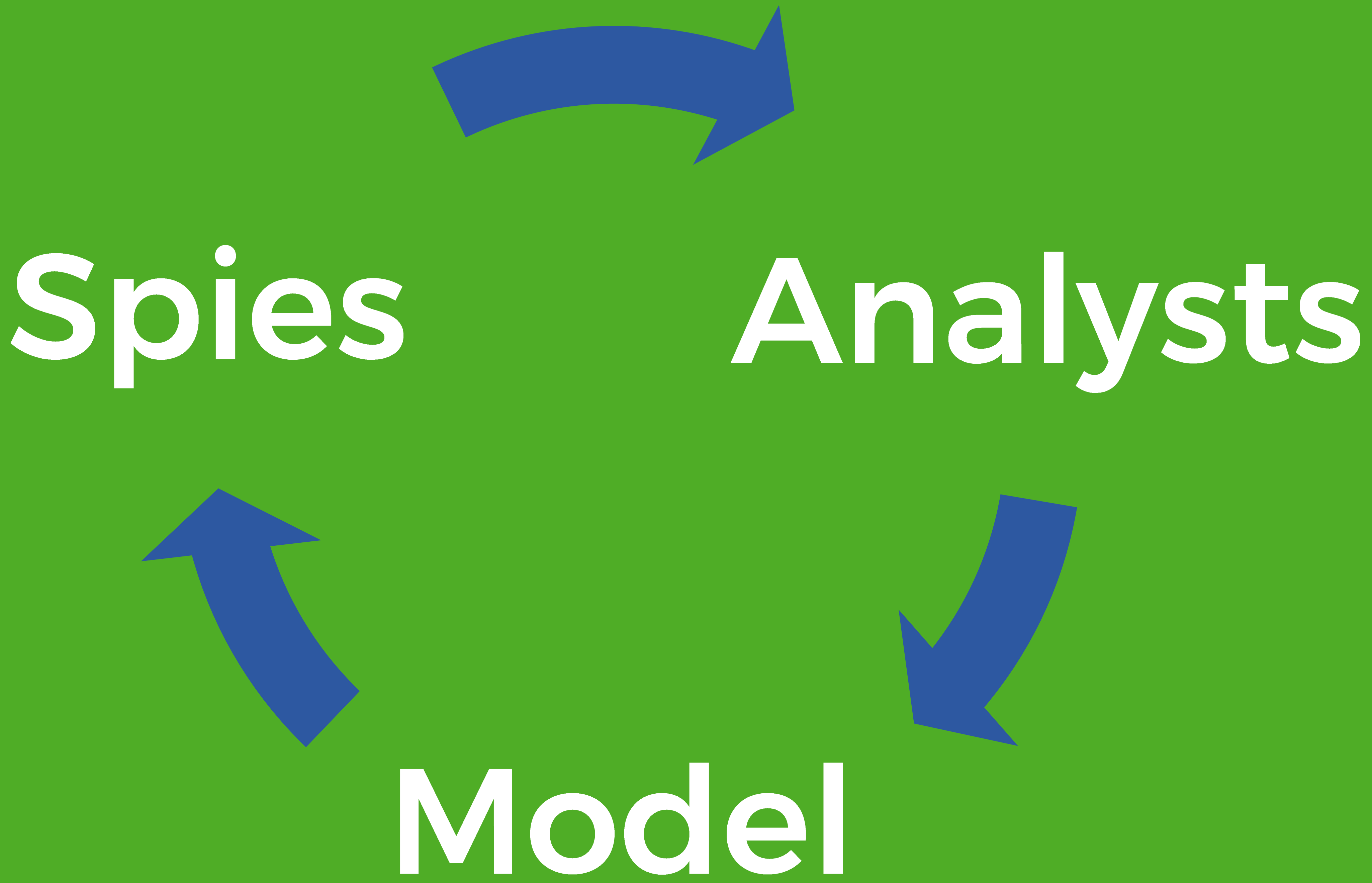
Your work



MODELING EXAMPLES

- ☐ MIDDLE SCHOOL
- ☐ HIGH SCHOOL


IVE
FOX NEWS
Junction


Spies
Analysts
Model

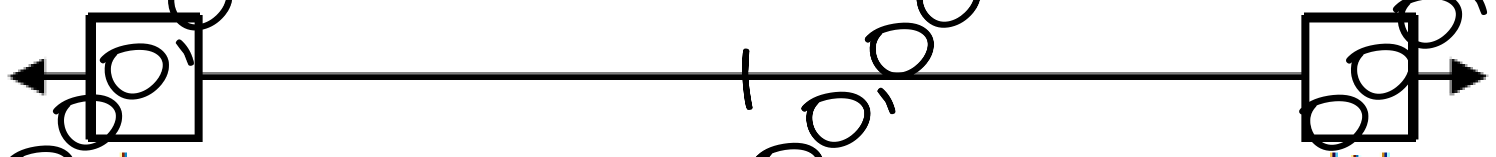
THINKING TIME

Name: ______________________ Period: __________ Date: ______________

What problem are you trying to figure out?

How much money was that?

What estimates do you have?



Place your estimate on the number line.

What info do you already know about the problem?

- There is a lot of money.
- It is in a pile.
- It is in bundles.

What info do you need about the problem?

- Is it all the same denomination?
- ~~How much does one bill weigh?~~
- ~~How much does all the money weigh?~~

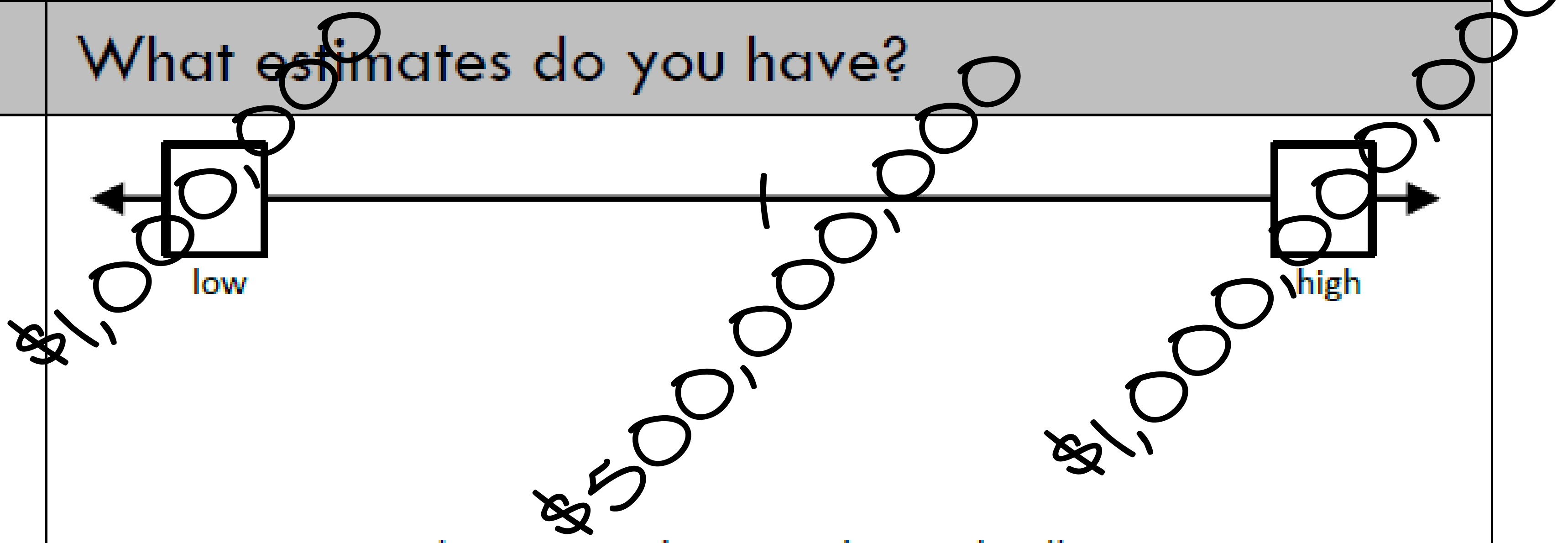
What is your conclusion? How did you reach that conclusion?

Name: ______________________ Period: __________ Date: ______________________

What problem are you trying to figure out?

How much money was that?

What estimates do you have?



Place your estimate on the number line.

What info do you already know about the problem?

- There is a lot of money.
- It is in a pile.
- It is in bundles.

What info do you need about the problem?

- Is it all the same denomination?
- How many rows and columns are there?
- How many bills are in one stack?

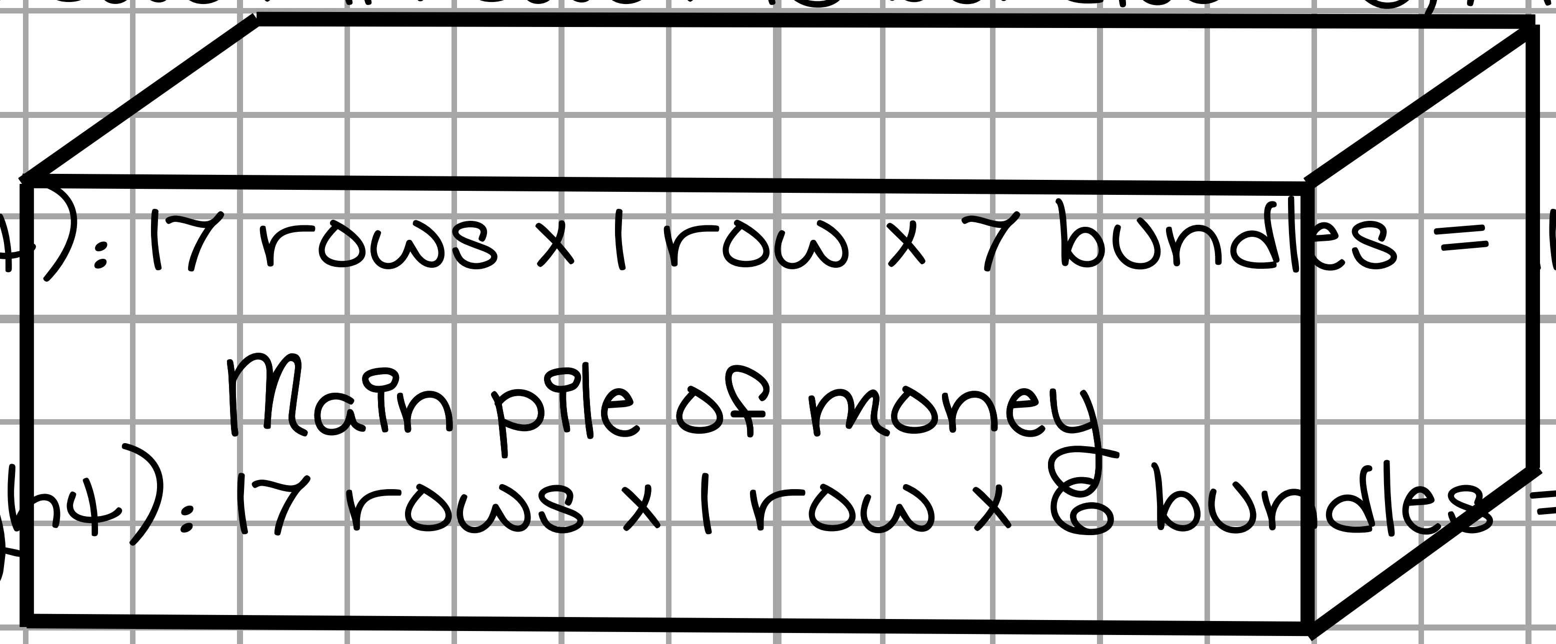
What is your conclusion? How did you reach that conclusion?


PGR
SIEDO


PGR
SIEDO
PGR
SIEDO

Your work

Main pile: 34 rows x 11 rows x 10 bundles = 3,740 bundles

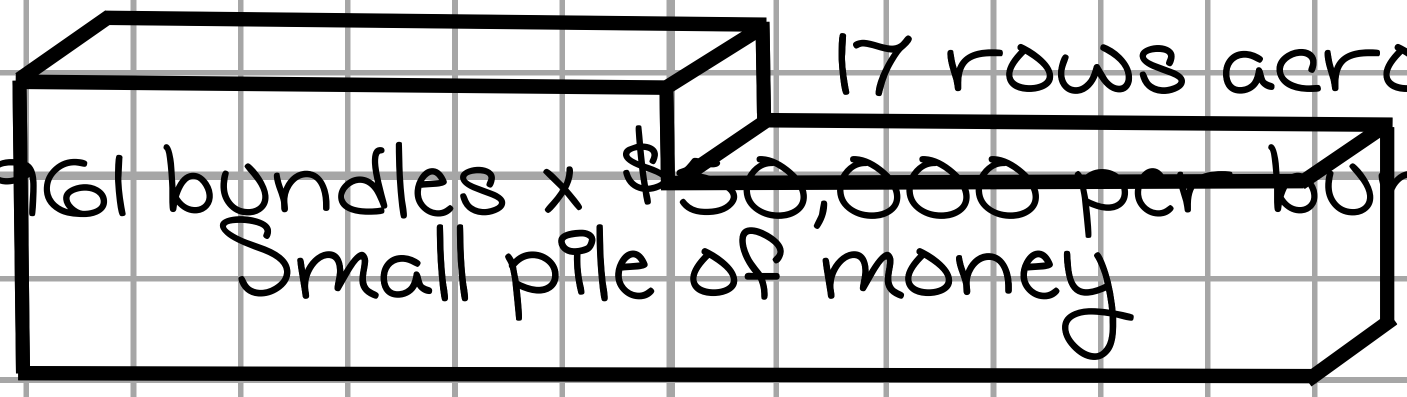


Small pile (left): 17 rows x 1 row x 7 bundles = 119 bundles

Small pile (right): 17 rows x 1 row x 6 bundles = 102 bundles

Total bundles: 3,740 + 119 + 102 = 3,961 bundles

Total money: 3,961 bundles x $50,000 per bundle = $198,050,000



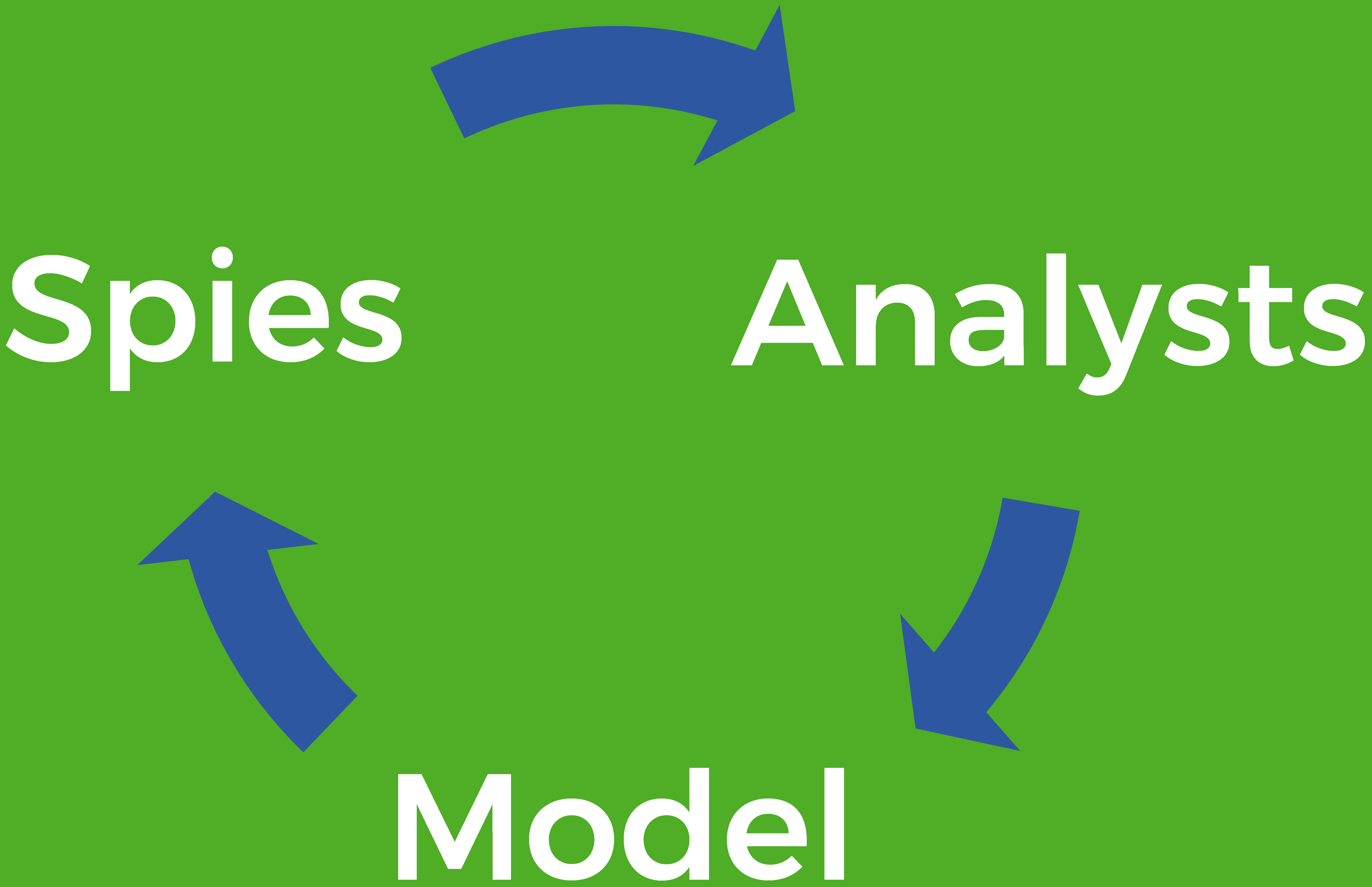

FOX
FOX NEWS

MODELING EXAMPLES

☑ MIDDLE SCHOOL

☐ HIGH SCHOOL


NON-STAGGERED
STAGGERED


Spies
Analysts
Model

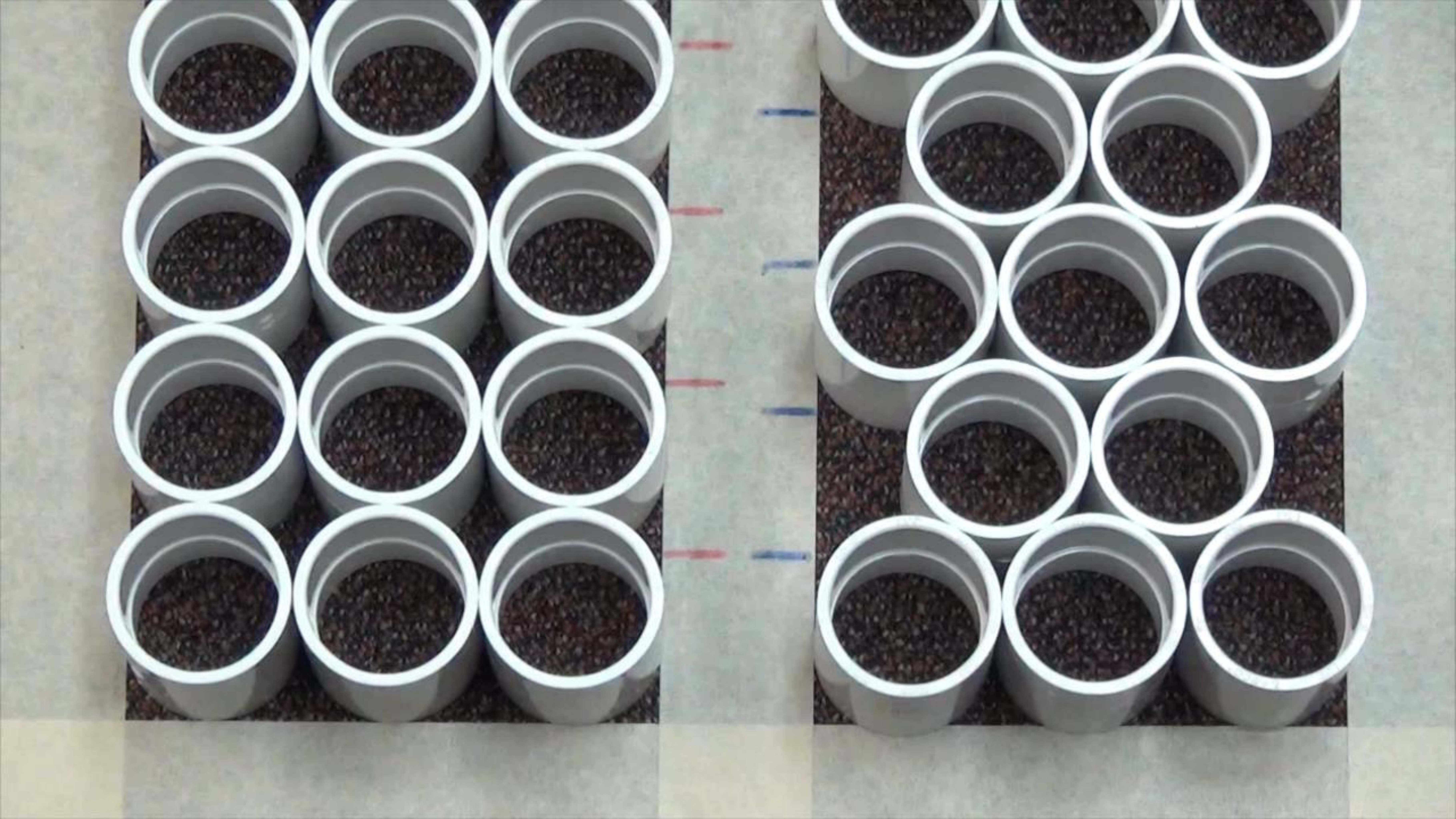
THINKING TIME

Name: ______________________ Period: __________ Date: ______________

What problem are you trying to figure out?	What estimates do you have?
How much shorter are 20 layers of non-staggered pipes?	3 (low) — 8 — 20 (high) (in inches) Place your estimate on the number line.
What info do you already know about the problem?	**What info do you need about the problem?**
• One pile of pipes is staggered. • One pile of pipes is not staggered. • We have to compare 20 layers of each.	• What are the dimensions of a pipe? • What units are we using to measure?

What is your conclusion? How did you reach that conclusion?

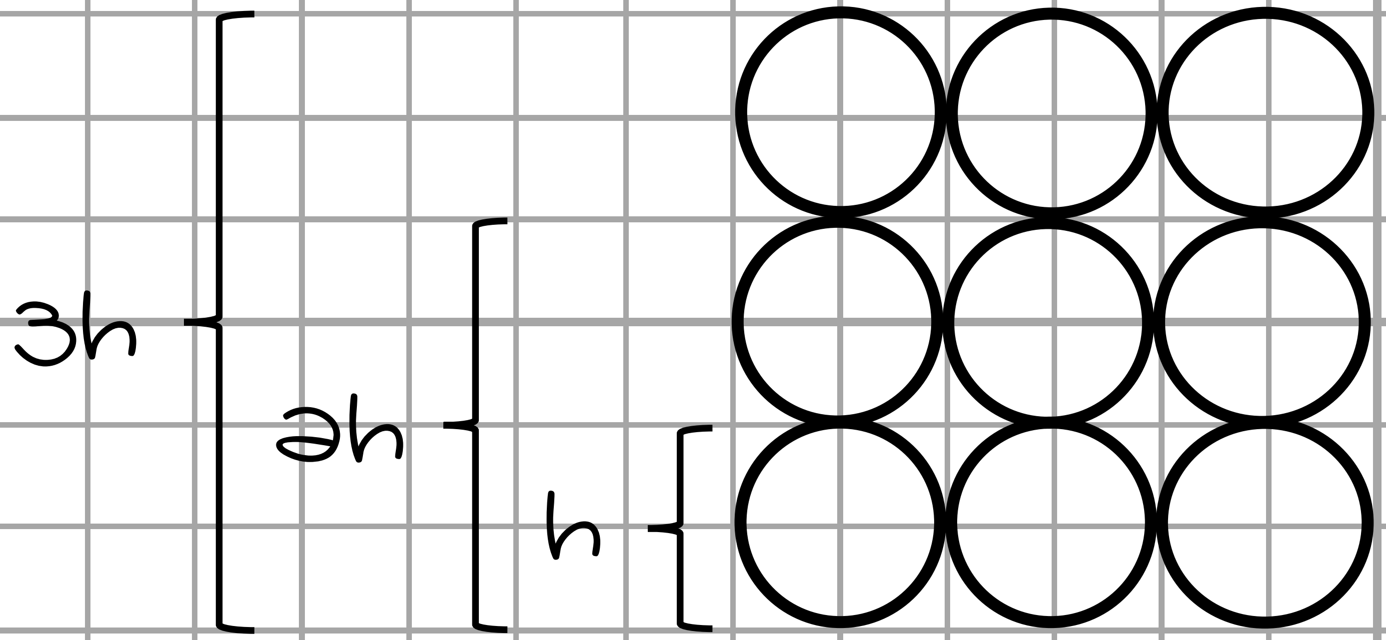

6 7



THINKING TIME

Your work

Non-staggered pipes



1 pipe = h cm

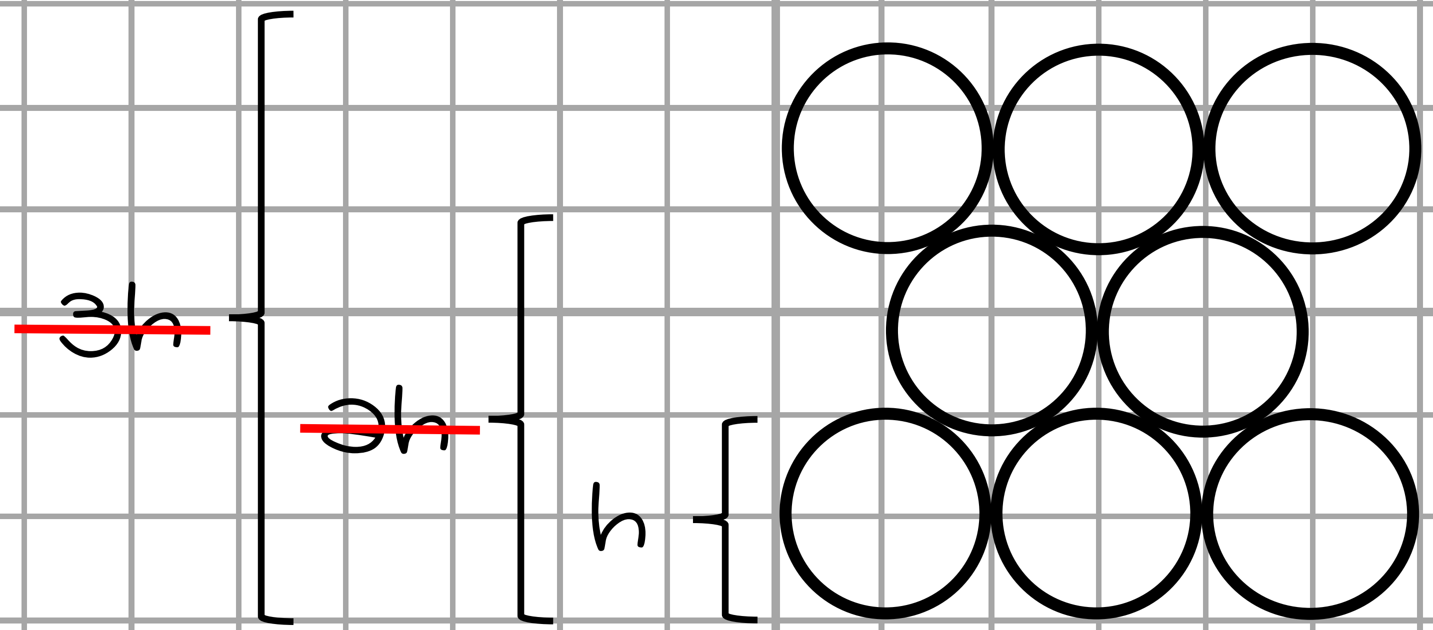
2 pipes = 2h cm

3 pipes = 3h cm

⋮

20 pipes = 20h cm

Staggered pipes



1 pipe = h cm

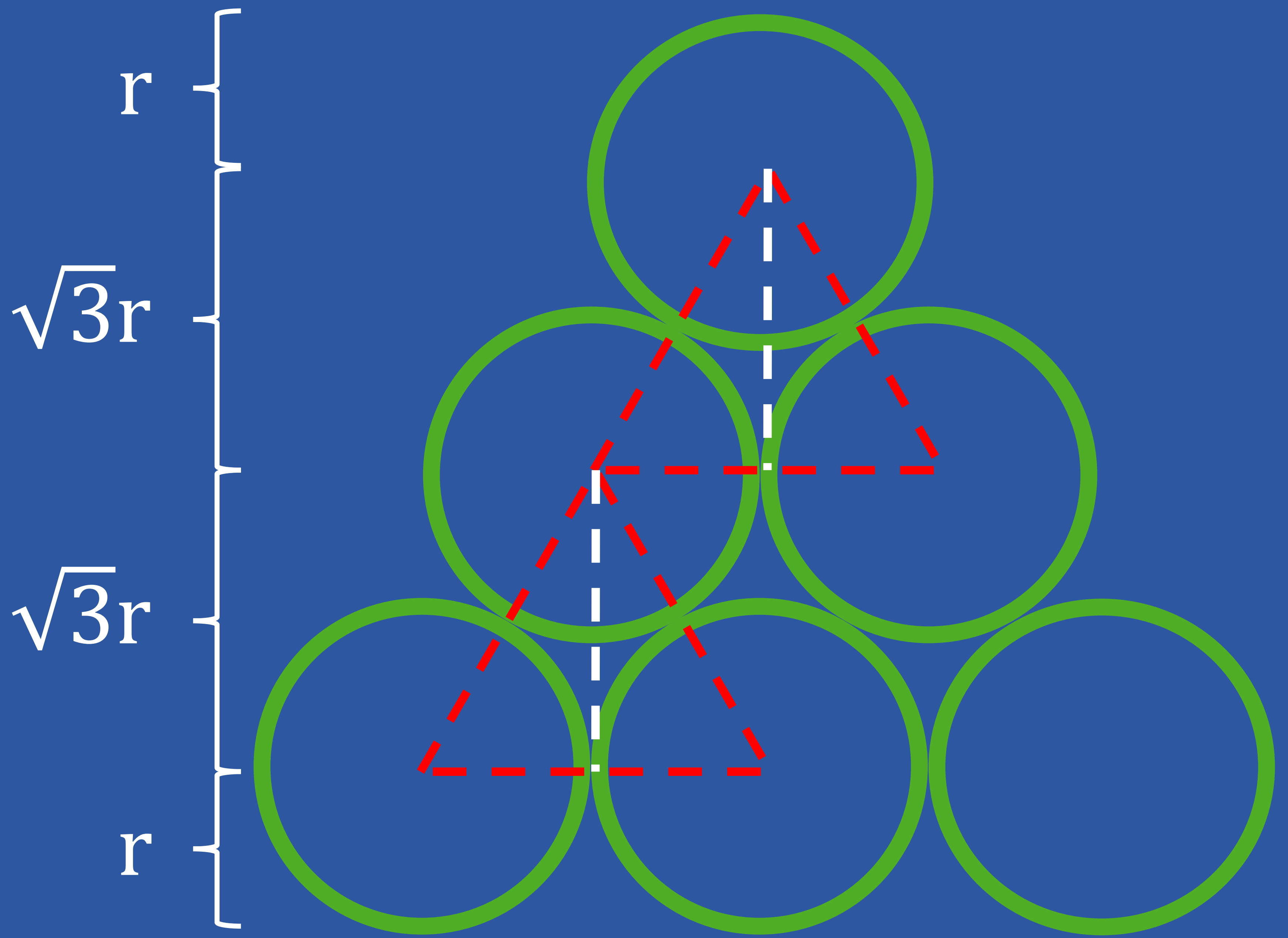
2 pipes = ?? cm

3 pipes = ?? cm

⋮

20 pipes = ?? cm

STAGGERED PIPES



MODELING EXAMPLES

☑ MIDDLE SCHOOL

☑ HIGH SCHOOL

MATH MODELING

- ☑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ☑ IS IT JUST ANSWERING QUESTIONS?
- ☑ HOW IS MATH MODELING USED IN REAL LIFE?
- ☑ HOW DO WE HELP OUR STUDENTS IMPROVE?

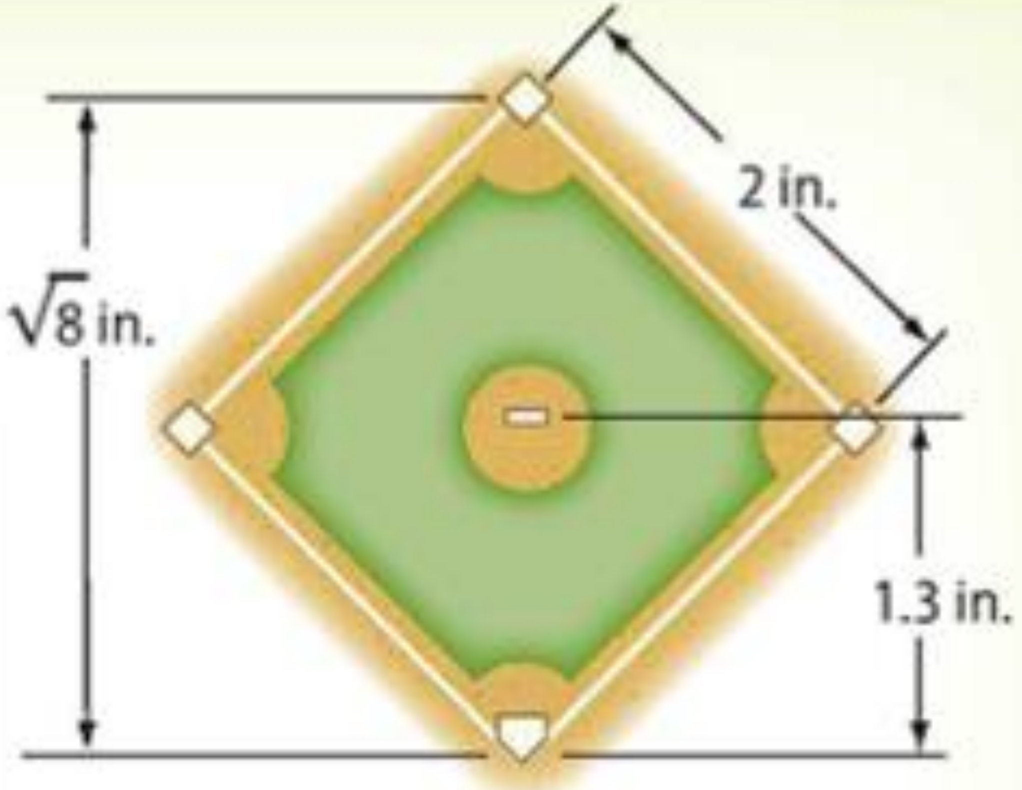
Real-World Link

Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



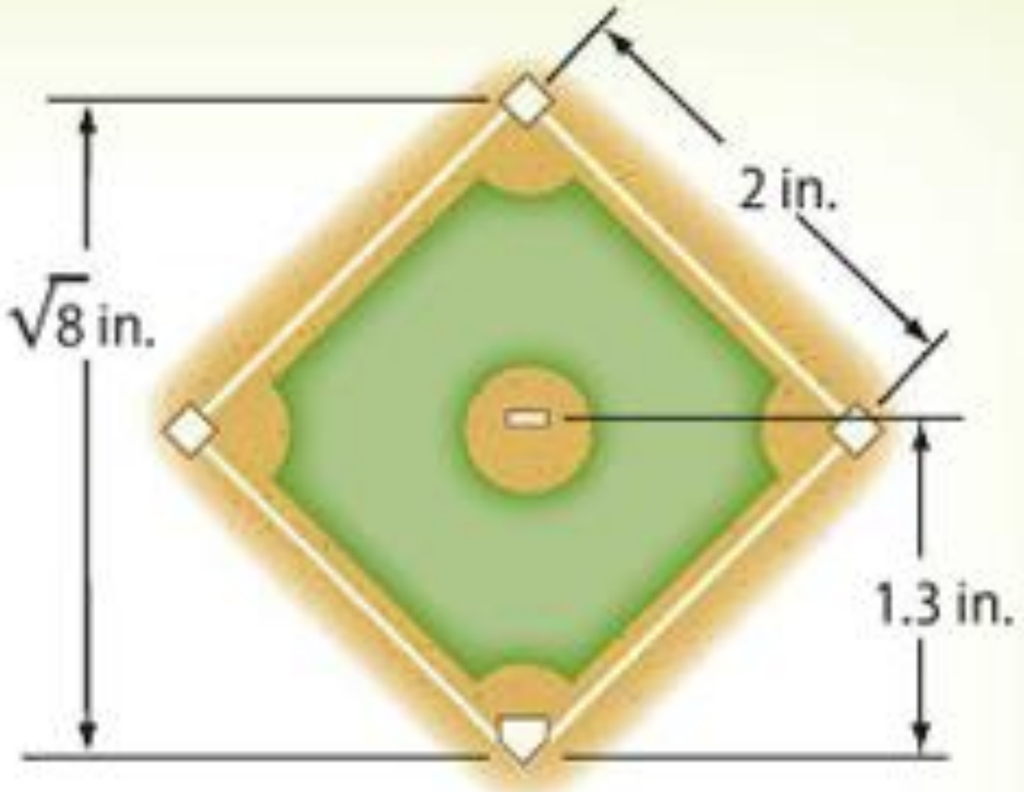
1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

Real-World Link

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



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3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

CCSS Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6


NETFLIX
2009
DATE: 09·21·09
PAY TO THE ORDER OF: BellKor's Pragmatic Chaos
$1,000,000 00
AMOUNT: ONE MILLION
00/100
FOR: The Netflix Prize
Reed Hastings

DISCUSSION TIME

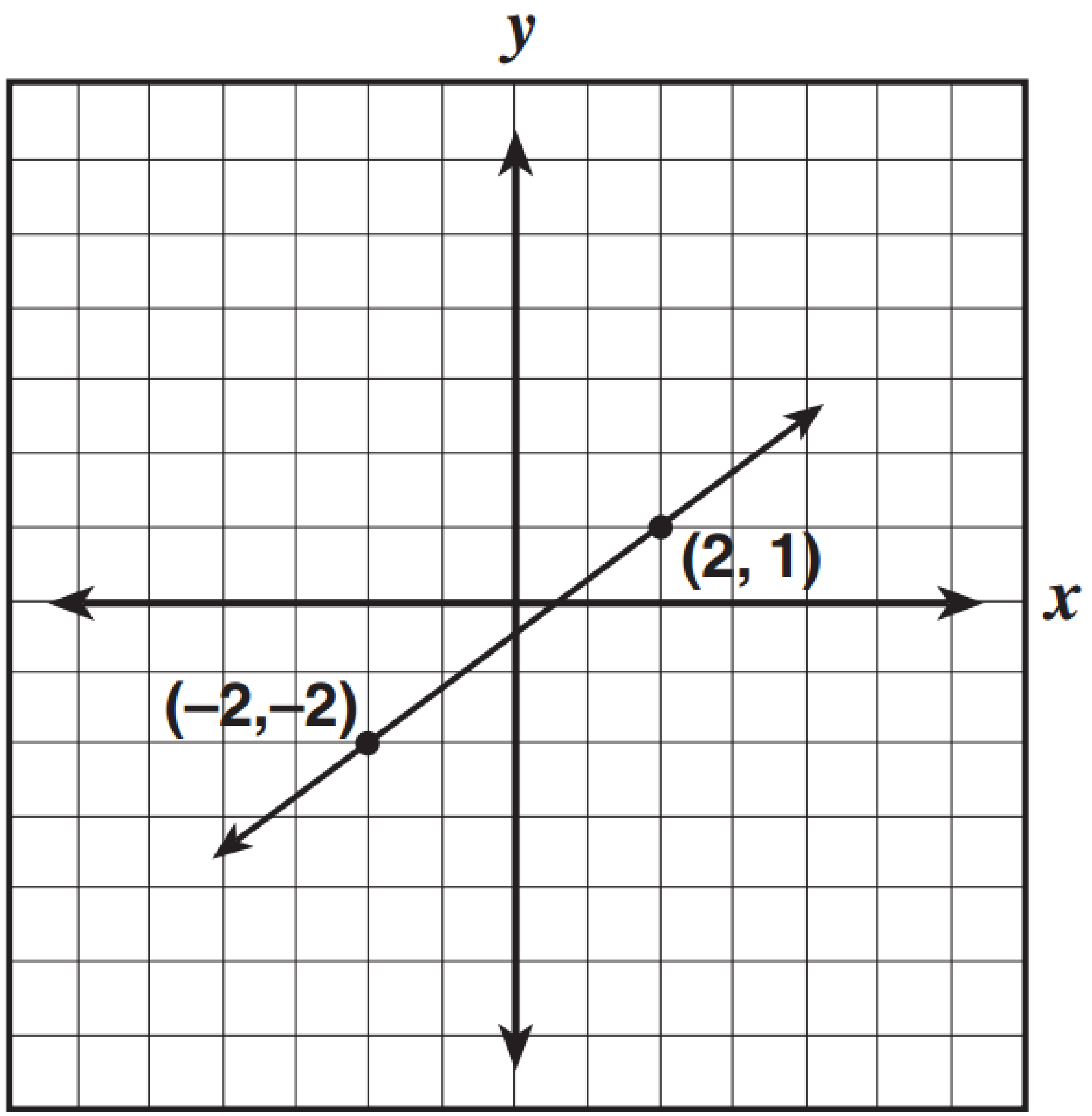
- Why should we reconsider using word problems?
- What should we be doing instead of word problems?

GOALS

- [x] CORRECT ANSWERS = UNDERSTANDING?
- [x] MAKE OUR LESSONS UNFORGETTABLE
- [x] RECONSIDER USING WORD PROBLEMS
- [ ] MAKE MATH CHALLENGING + ACCESSIBLE

Student Name	ID Number	Perf. Level	Scaled Score	Mathematics Clusters (Clusters where the percent correct is shown in bold represent proficiency for that cluster.) Rational numbers		Exponents, powers, and roots		Quantitative relationships and evaluating expressions		Multi-step problems, graphing, and functions		Measurement and geometry		Statistics, data analysis, and probability	
				Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct
[illegible]	[illegible]	ADV	476	13	93%	8	100%	8	80%	14	93%	12	92%	5	100%
[illegible]	[illegible]	ADV	464	13	93%	7	88%	8	80%	15	100%	11	85%	5	100%
[illegible]	[illegible]	ADV	453	10	71%	8	100%	10	100%	14	93%	11	85%	5	100%
[illegible]	[illegible]	ADV	453	13	93%	8	100%	9	90%	12	80%	11	85%	5	100%
[illegible]	[illegible]	ADV	444	14	100%	7	88%	8	80%	13	87%	10	77%	5	100%
[illegible]	[illegible]	ADV	444	12	86%	8	100%	8	80%	15	100%	10	77%	4	80%
[illegible]	[illegible]	ADV	444	13	93%	8	100%	8	80%	14	93%	9	69%	5	100%
[illegible]	[illegible]	ADV	435	12	86%	6	75%	9	90%	14	93%	10	77%	5	100%
[illegible]	[illegible]	ADV	435	12	86%	6	75%	8	80%	14	93%	11	85%	5	100%
[illegible]	[illegible]	ADV	435	13	93%	7	88%	9	90%	12	80%	10	77%	5	100%
[illegible]	[illegible]	ADV	427	13	93%	6	75%	9	90%	12	80%	10	77%	5	100%
[illegible]	[illegible]	ADV	427	13	93%	7	88%	6	60%	13	87%	11	85%	5	100%
[illegible]	[illegible]	ADV	427	14	100%	5	63%	7	70%	14	93%	10	77%	5	100%
[illegible]	[illegible]	ADV	421	13	93%	6	75%	6	60%	14	93%	10	77%	5	100%
[illegible]	[illegible]	ADV	421	11	79%	5	63%	9	90%	13	87%	11	85%	5	100%
[illegible]	[illegible]	ADV	414	12	86%	6	75%	8	80%	11	73%	11	85%	5	100%
[illegible]	[illegible]	ADV	414	12	86%	8	100%	8	80%	13	87%	8	62%	4	80%
[illegible]	[illegible]	PRO	408	11	79%	6	75%	9	90%	11	73%	10	77%	5	100%
[illegible]	[illegible]	PRO	402	12	86%	8	100%	9	90%	8	53%	11	85%	3	60%
[illegible]	[illegible]	PRO	402	8	57%	7	88%	8	80%	13	87%	10	77%	5	100%
[illegible]	[illegible]	PRO	402	13	93%	6	75%	7	70%	13	87%	8	62%	4	80%
[illegible]	[illegible]	PRO	402	11	79%	5	63%	7	70%	11	73%	12	92%	5	100%
[illegible]	[illegible]	PRO	402	13	93%	7	88%	9	90%	10	67%	7	54%	5	100%
[illegible]	[illegible]	PRO	402	13	93%	7	88%	7	70%	11	73%	8	62%	5	100%
[illegible]	[illegible]	PRO	396	10	71%	6	75%	9	90%	14	93%	7	54%	4	80%
[illegible]	[illegible]	PRO	396	12	86%	8	100%	6	60%	9	60%	11	85%	4	80%

52 What is the slope of this line?



A $\frac{1}{2}$

B $\frac{3}{4}$

C 1

D $\frac{4}{3}$

Source: California Released Test Questions (7th Grade Math)


X-RAY
VISION

Student Name	ID Number	Perf. Level	Scaled Score	Mathematics Clusters (Clusters where the percent correct is shown in bold represent proficiency for that cluster.)											
				Rational numbers		Exponents, powers, and roots		Quantitative relationships and evaluating expressions		Multi-step problems, graphing, and functions		Measurement and geometry		Statistics, data analysis, and probability	
				Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct
[illegible]	[illegible]	ADV	476	13	93%	8	100%	8	80%	14	93%	12	92%	5	100%
[illegible]	[illegible]	ADV	464	13	93%	7	88%	8	80%	15	100%	11	85%	5	100%
[illegible]	[illegible]	ADV	453	10	71%	8	100%	10	100%	14	93%	11	85%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	100%	[illegible]	[illegible]	[illegible]	[illegible]	11	85%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	77%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	77%	4	80%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9	69%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	77%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	85%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	88%	[illegible]	[illegible]	[illegible]	[illegible]	10	77%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6	75%	[illegible]	[illegible]	[illegible]	[illegible]	10	77%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7	88%	[illegible]	[illegible]	[illegible]	[illegible]	11	85%	5	100%
[illegible]	[illegible]	ADV	[illegible]	[illegible]	[illegible]	5	63%	[illegible]	[illegible]	[illegible]	93%	10	77%	5	100%
[illegible]	[illegible]	ADV	421	[illegible]	93%	6	75%	6	[illegible]	[illegible]	93%	10	77%	5	100%
[illegible]	[illegible]	ADV	421	11	79%	5	63%	9	90%	13	87%	11	85%	5	100%
[illegible]	[illegible]	ADV	414	12	86%	6	75%	8	80%	11	73%	11	85%	5	100%
[illegible]	[illegible]	ADV	414	12	86%	8	100%	8	80%	13	87%	8	62%	4	80%
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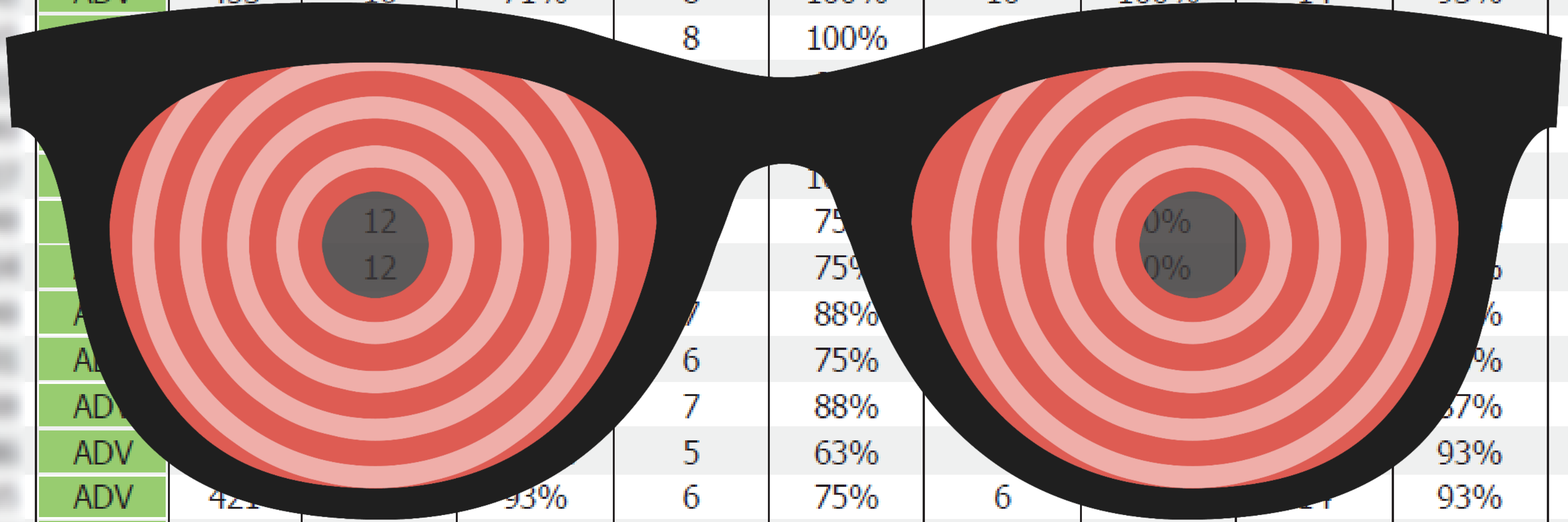
[illegible]	[illegible]	PRO	402	11	79%	5	63%	7	70%	11	73%	12	92%	5	100%
[illegible]	[illegible]	PRO	402	13	93%	7	88%	9	90%	10	67%	7	54%	5	100%
[illegible]	[illegible]	PRO	402	13	93%	7	88%	7	70%	11	73%	8	62%	5	100%
[illegible]	[illegible]	PRO	396	10	71%	6	75%	9	90%	14	93%	7	54%	4	80%
[illegible]	[illegible]	PRO	396	12	86%	8	100%	6	60%	9	60%	11	85%	4	80%



X-RAY VISION PROBLEMS

- [x] WHY DO WE NEED THEM?
- [ ] WHY ARE THEY DIFFERENT?
- [ ] HOW DO YOU IMPLEMENT THEM?
- [ ] HOW DO YOU CREATE YOUR OWN?

PROBLEM ONE

Solve for x.

$$21 + x = 70$$

PROBLEM TWO

Using the digits 1 to 9, at most one time each, create two equations: one where x has a positive value and one where x has a negative value.

$$\boxed{}\,\boxed{} + x = \boxed{}\,\boxed{}$$

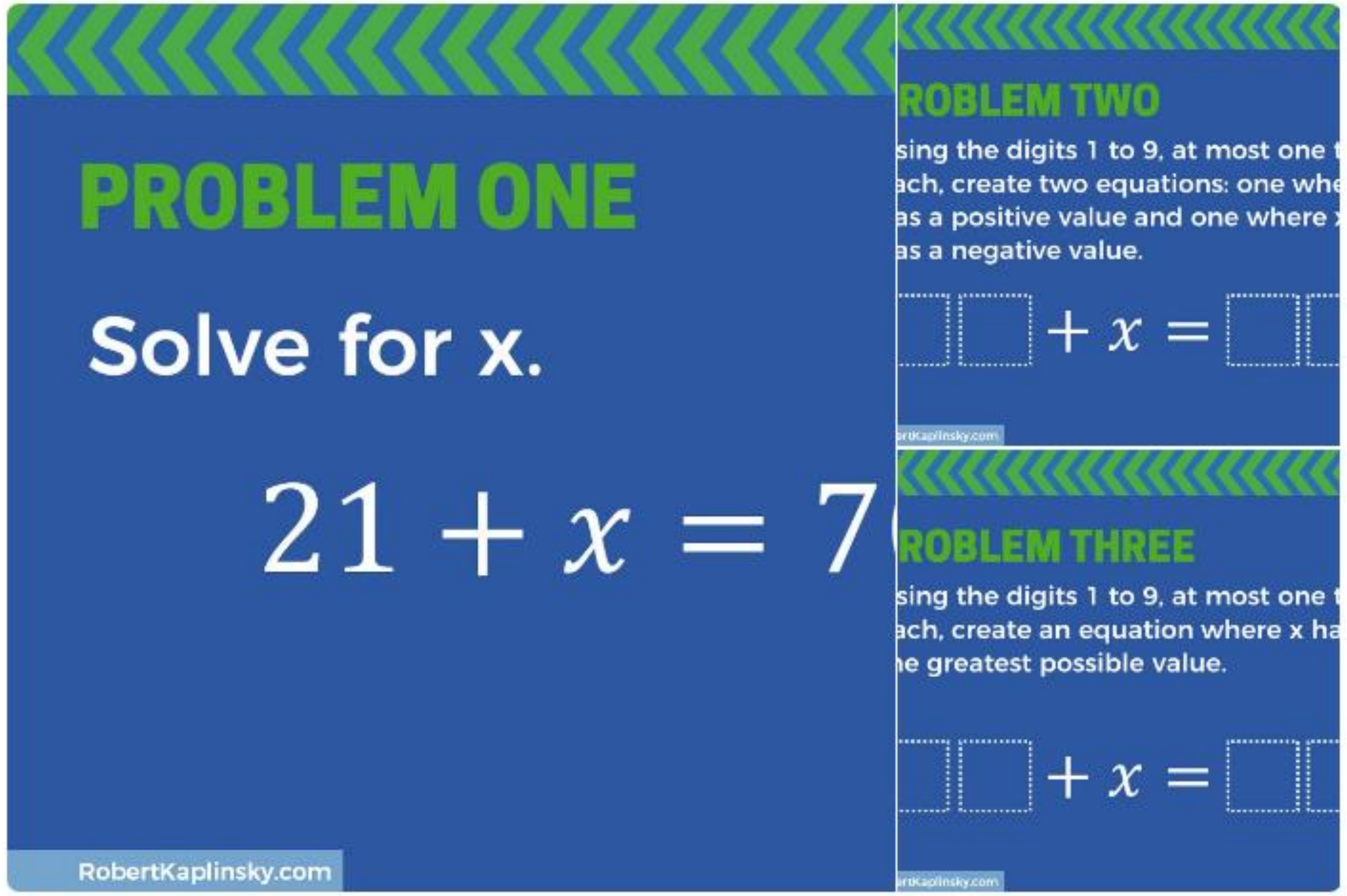
PROBLEM THREE

Using the digits 1 to 9, at most one time each, create an equation where x has the greatest possible value.

$$\boxed{}\,\boxed{} + x = \boxed{}\,\boxed{}$$

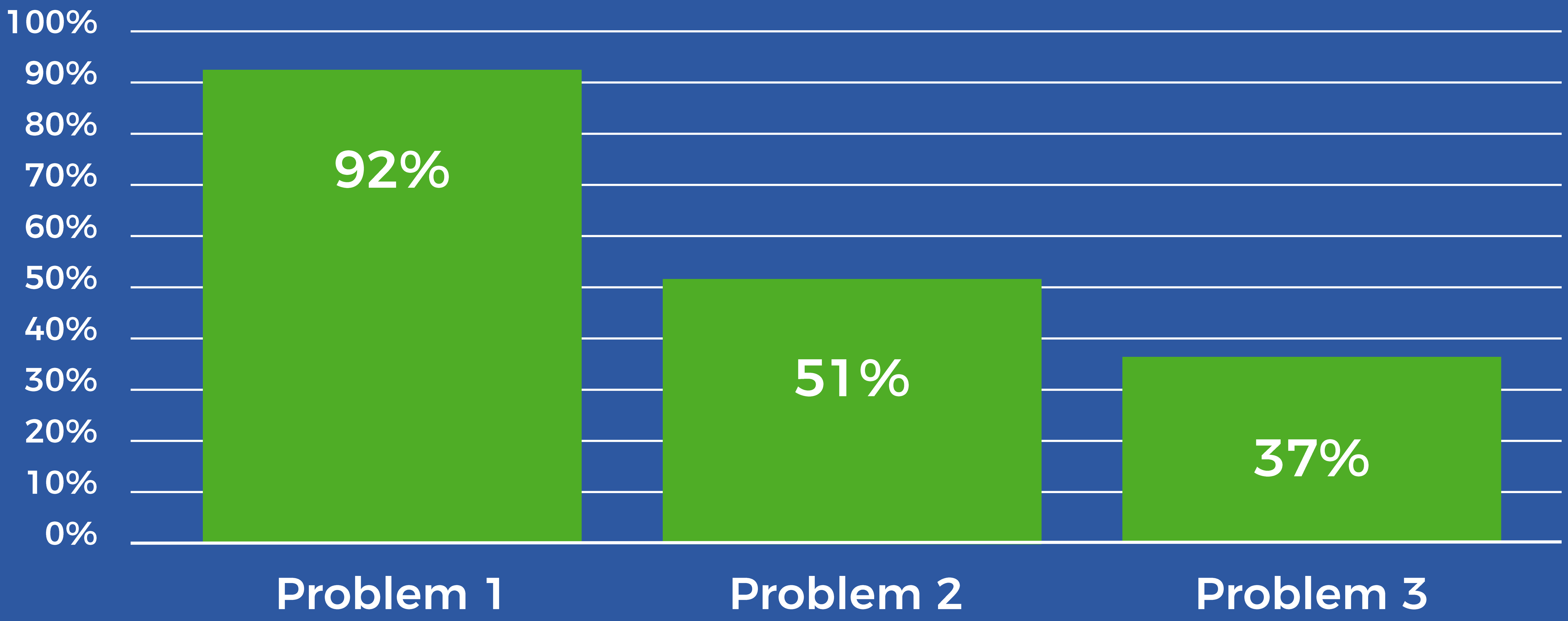
Robert Kaplinsky
@robertkaplinsky

MS & HS #MTBoS Ts, please ask your Ss these 3 ?s and put the % who answered correctly here: docs.google.com/forms/d/e/1FAI …. Answers at top of form.



RETWEETS 36 LIKES 54

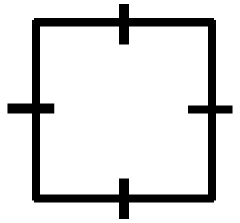
PROBLEM RESULTS



Depth of Knowledge Matrix - Secondary Math

Topic	Dividing Fractions	Solving Two-Step Equations	Exponents	Solving Equations with Variables on Both Sides
CCSS Standard(s)	• 6.NS.1	• 7.EE.4a	• 8.EE.1	• 8.EE.8 • A-REI.3
DOK 1 Example	Evaluate. $\frac{4}{9} \div \frac{2}{5}$	Solve for x. $2x + 3 = 9$	Evaluate. 3^4	Solve for x. $3x + 2 = -2x + 4$
DOK 2 Example	Use the digits 1 to 9, at most one time each, to fill in the boxes to make two different pairs of fractions that have a quotient of 2/3. $\frac{\square}{\square} \div \frac{\square}{\square} = \frac{2}{3}$	Use the digits 1 to 9, at most one time each, to create two equations: one where x has a positive value and one where x has a negative value. $\square x + \square = \square$	Use the digits 1 to 9, at most one time each, to fill in the boxes to make two true number sentences. $\square^{\square} = 64$	Use the digits 1 to 9, at most <u>two</u> times each, to fill in the boxes to make an equation with no solutions. $\square x + \square = \square x + \square$
DOK 3 Example	Use the digits 1 to 9, at most one time each, to fill in the boxes to make two fractions that have a quotient that is as close to 4/11 as possible. $\frac{\square}{\square} \div \frac{\square}{\square}$	Use the digits 1 to 9, at most one time each, to create an equation where x has the greatest possible value. $\square x + \square = \square$	Use the digits 1 to 9, at most one time each, to fill in the boxes to make a result that has the greatest value possible. $\square^{\square} = \square\square\square$	Use the digits 1 to 9, at most one time each, to fill in the boxes so that the solution is closest to zero. $\square x + \square = \square x + \square$

Depth of Knowledge Matrix - Secondary Math

Topic	Geometric Proofs	Complex Numbers	Trigonometric Functions	Definite Integral
CCSS Standard(s)	• G-CO.11	• N-CN.2	• F-TF.3	• N/A
DOK 1 Example	Add one geometric marking to demonstrate the quadrilateral is a square. 	Multiply the binomials. $(3+4i)(2+3i)$	Evaluate. $\sin\frac{\pi}{3}$	Solve. $\int_{2}^{6} x^{3}\,dx$
DOK 2 Example	Use exactly 5 geometric markings to show that a quadrilateral is a square.	Use the integers -9 to 9, at most one time each, to fill in the boxes twice: once to make a positive real number product and once to make a negative real number product. $(\square+\square i)(\square+\square i)$	Use the digits 1 to 9, at most one time each, to fill in the boxes and make two true number sentences. $\sin\frac{\square\pi}{\square}=0$	Use the digits 1 to 9, at most one time each, to fill in the boxes and make a positive and a negative solution. $\int_{\square}^{\square} x^{\square}\,dx$
DOK 3 Example	What is the least number of geometric markings needed to demonstrate that a quadrilateral is a square?	Use the integers -9 to 9, at most one time each, to fill in the boxes and make a real number product with the greatest value. $(\square+\square i)(\square+\square i)$	Use the digits 1 to 9, at most one time each, so that the function has the greatest possible value. $\sin\frac{\square\pi}{\square}=\frac{\sqrt{\square}}{\square}$	Use the digits 1 to 9, at most one time each, to fill in the boxes and make a solution that is as close to 100 as possible. $\int_{\square}^{\square} x^{\square}\,dx$

Robert Kaplinsky

More free DOK 2 & 3 problems available at openmiddle.com

Version 1.5

X-RAY VISION PROBLEMS

- ☑ WHY DO WE NEED THEM?
- ☑ WHY ARE THEY DIFFERENT?
- ☐ HOW DO YOU IMPLEMENT THEM?
- ☐ HOW DO YOU CREATE YOUR OWN?

IMPLEMENTATION

- Open Middle Worksheet

First attempt: Points: ____/2 attempt ____/2 explanation

What did you learn from this attempt? How will your strategy change on your next attempt?

Name: ______________________________ Period: ________ Date: ______________

First attempt: Points: ____/2 attempt ____/2 explanation

What did you learn from this attempt? How will your strategy change on your next attempt?

Second attempt: Points: ____/2 attempt ____/2 explanation

IMPLEMENTATION

- Open Middle Worksheet
- Classwork
  - Single problem for entire class
  - Extensions menu

QUESTION #1

Use the digits 1 to 9, at most one time each, to create an equation where x has the greatest possible value.

$$\square\square + x = \square\square$$

4 points

QUESTION #2

Solve for x.

$$3x + 7 = 19$$

1 point

QUESTION #3

Use the digits 1 to 9, at most one time each, to create two equations: one where x has a positive value and one where x has a negative value.

$$\square\square + x = \square\square$$

2 points

QUESTION #4

Use the digits 1 to 9, at most one time each, to make each equation true.

$$\square + a = \square$$

SOLVING EQUATIONS EXTENSION MENU

You must earn **<u>at least 12 points</u>** by doing the problems of your choice. Circle the questions you

QUESTION #5

Use the digits 1 to 9, at most one time each, to create an equation where x has the greatest possible value.

IMPLEMENTATION

- Open Middle Worksheet
- Classwork
  - Single problem for entire class
  - Extensions menu
- Homework
- Assessments

X-RAY VISION PROBLEMS

- [x] WHY DO WE NEED THEM?
- [x] WHY ARE THEY DIFFERENT?
- [x] HOW DO YOU IMPLEMENT THEM?
- [ ] HOW DO YOU CREATE YOUR OWN?

STEP ONE

- Find a One-Operation Problem
  - Addition
  - Subtraction
  - Multiplying
  - Dividing
  - Exponents (including square root)
  - Trigonometric functions

ADDING 2-DIGIT NUMBERS

Solve.

$$41 + 36 =$$

MULTIPLYING FRACTIONS

Solve.

$$\frac{3}{7} \times \frac{2}{9} =$$

THINKING TIME

STEP TWO

- Go from DOK 1 to DOK 2
  - Strategically remove some information from the problem to prevent immediate calculation
  - Increase the quantity of solutions needed to increase the need to look for patterns

ADDING 2-DIGIT NUMBERS

Using the digits 1 to 9, at most one time each, fill in the boxes to make two different pairs of two-digit numbers that have a sum of 71.

$$\boxed{}\,\boxed{} + \boxed{}\,\boxed{} = 71$$

MULTIPLYING FRACTIONS

Using the digits 1 to 9, at most one time each, fill in the boxes to make two different pairs of fractions that have a product of 2/3.

$$\frac{\square}{\square} \times \frac{\square}{\square} = \frac{2}{3}$$

THINKING TIME

- Go from DOK 1 to DOK 2
  - Strategically remove some information from the problem to prevent immediate calculation
  - Increase the quantity of solutions needed to increase the need to look for patterns

STEP THREE

- Go from DOK 2 to DOK 3
  - Introduce the need to optimize the solution by making the greatest or least product / sum / difference / quotient / answer.
  - Another optimization option is make the answer closest to a specific value.

ADDING 2-DIGIT NUMBERS

Using the digits 1 to 9, at most one time each, fill in the boxes to make the smallest sum.

$\boxed{1}\,\boxed{3} + \boxed{2}\,\boxed{5} = \boxed{4}\,\boxed{0}$

MULTIPLYING FRACTIONS

Using the digits 1 to 9, at most one time each, fill in the boxes to make two fractions that have a product that is as close to 4/11 as possible.

$$\frac{\square}{\square} \times \frac{\square}{\square}$$

THINKING TIME

- Go from DOK 2 to DOK 3
  - Introduce the need to optimize the solution by making the greatest or least product / sum / difference / quotient / answer.
  - Another optimization option is make the answer closest to a specific value.

3 Steps to Increase Math DOK Levels

Step 1: Find a One-Operation Problem

- Procedural problems with one operation are easiest to modify.
- Other problems may also be modified but may not be as easy.

Adding 2-Digit Numbers
Solve.

41 + 36 = ___

Multiplying Fractions
Solve.

$\frac{3}{7} \times \frac{2}{9} =$ ___

Trigonometry
Solve.

$\sin \frac{\pi}{3} =$ ___

Step 2: Go from DOK 1 to DOK 2

- Strategically remove some information from the problem to prevent immediate calculation
- Increase the quantity of solutions needed to increase the need to look for patterns

Adding 2-Digit Numbers
Using the digits 1 to 9, at most one time each, fill in the boxes

Multiplying Fractions
Using the digits 1 to 9, at most one time each, fill in the boxes

Trigonometry
Using the digits 1 to 9, at most one time each, fill in the boxes

X-RAY VISION PROBLEMS

- ☑ WHY DO WE NEED THEM?
- ☑ WHY ARE THEY DIFFERENT?
- ☑ HOW DO YOU IMPLEMENT THEM?
- ☑ HOW DO YOU CREATE YOUR OWN?

Open Middle @openmiddle · Jan 11

Open Middle
@openmiddle

Hey @openmiddle fans, we want to hear from you. Why do you use our problems with your students? Share your success stories or lessons learned.

RETWEETS 7 LIKES 6

2:10 PM - 11 Jan 2017

8 7 6

1 2

DISCUSSION TIME

- How can x-ray vision problems like the kinds on Open Middle spot misconceptions that may often go unnoticed?
- How do Open Middle problems make mathematics accessible yet appropriately challenging for every student?

GOALS

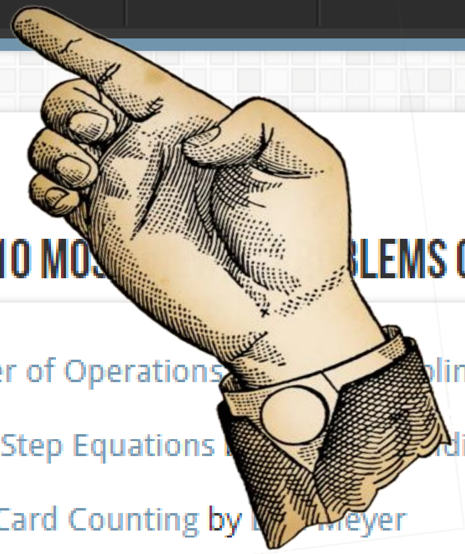
- ☑ CORRECT ANSWERS = UNDERSTANDING?
- ☑ MAKE OUR LESSONS UNFORGETTABLE
- ☑ RECONSIDER USING WORD PROBLEMS
- ☑ MAKE MATH CHALLENGING + ACCESSIBLE

PROBLEM RESOURCES

- Problem-based lesson search engine: robertkaplinsky.com/prbl-search-engine
- My lessons (Elementary, Middle, and High School) robertkaplinsky.com/lessons
- Dan Meyer (Middle and High School) threeacts.mrmeyer.com
- Andrew Stadel (Elementary and Middle School) estimation180.com/lessons.html
- Graham Fletcher (Elementary and Middle School) gfletchy.com/3-act-lessons

Open Middle™

Challenging math problems worth solving



THE TOP 10 MO… …LEMS OF 2017

1. Order of Operations … plinsky with answer from Michael Fenton and his students
2. Two-Step Equations … divil, Daniel Luevanos, and Robert Kaplinsky
3. Dot Card Counting by … eyer
4. Two-Step Equations 3 by Erick Lee 5. One Solution, No Solutions, Infinite Solutions by Bryan Anderson
6. Multiplying a Two-Digit Number by a Single-Digit Number by Robert Kaplinsky
7. Exponents and Order of Operations by Zack Miller
8. Rational and Irrational Numbers by Bryan Anderson
9. Converting Between Fractions and Decimals by Robert Kaplinsky
10. Interpretting Percentages by Robert Kaplinsky

WHAT ARE PEOPLE SAYING ABOUT OPEN MIDDLE?

Brian Marks
@Yummymath

Have you checked out openmiddle.com @openmiddle Should be on your short list of math ed resources #MTBoS #mathchat #maths #elemchat

Search

OPEN MIDDLE WORKSHEET

- English (student version)
- English (document camera version)
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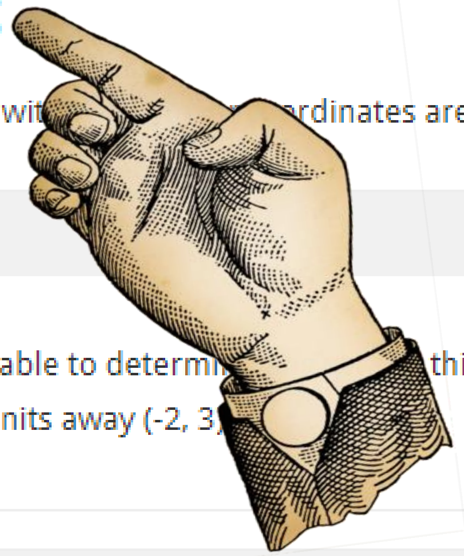
BROWSE BY COMMON CORE STATE STANDARDS

- Kindergarten (12)
  - Counting & Cardinality (3)
  - Geometry (3)
  - Number & Operations in Base Ten (1)
  - Operations & Algebraic Thinking (5)
- Grade 1 (17)
  - Geometry (3)
  - Measurement & Data (4)
  - Number & Operations in Base Ten (3)
  - Operations & Algebraic Thinking (7)

EQUIDISTANT POINTS



Directions: How many points wit ... rdinates are 5 units away from (-2, 3)?

Hint

Which methods are available to determi ... this problem? What shape is defined by *all* of the points that are 5 units away (-2, 3)

Answer

12 points: (-5, 7), (-7, 3), (-5, -1), (-2, -2), (3, 3), (1, -1), (-2, 8), (1, 7), (2,6), (-6, -6), (-6, 0), and (2, 0)

Source: Dylan Kane

Print

Tags 8.G.8 DOK 2: SKILL / CONCEPT DYLAN KANE G-GPE.1

Search

OPEN MIDDLE WORKSHEET

English (student version)
English (document camera version)
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BROWSE BY COMMON CORE STATE STANDARDS

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  - Operations & Algebraic Thinking (7)

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3

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Lessons

View all | Kinder | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th | Alg 1 | Geo | Alg 2

How Much Money Were Those Pennies?

How Can We #SaveNelly?

How Many Chip Bags Will There Be?

How Can We Make Stronger Passwords?

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Job Role(s)

- Elementary School
- Middle School
- High School
- Higher Education

Resources

Depth of Knowledge

- Open Middle
- Open Middle Worksheet – English (student version)
- Open Middle Worksheet – English (document camera version)
- Open Middle Worksheet – Spanish (student version)
- Open Middle Worksheet – Spanish (document camera version)
- Robert's blog posts on Depth of Knowledge
- Tool to Distinguish Between Depth of Knowledge Levels

Problem-Based Lesson Tools

- Problem-Based Lesson Search Engine
- Problem Solving Framework v8.1
- Robert's blog posts on Problem-Based Learning

Problem-Based Lesson Sources

- 101 Questions
- Andrew Gael
- Andrew Stadel
- Catherine Castillo
- Christina Tondevold
- Dan Meyer
- Dane Ehlert
- Emergent Math's Problem Based Curriculum Maps

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Zip Code (optional)

Job Role(s)

- Elementary School
- Middle School
- High School
- Higher Education

Robert Kaplinsky's Problem-Based Lessons

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

	A	B	C	D	E	F	G	H	I
1	Lesson	Concept / Skill	Standard 1	Standard 2	Standard 3	Standard 4	Standard 5	Standard 6	Stand 7
2	How Much Money Were Those Pennies?	Money, Multiplying Decimals, Proportions	4.MD.2	5.NBT.5	5.NBT.7	7.RP.3			
3	How Can We #SaveNelly?	Dividing Decimals	6.NS.3						
4	How Many Chip Bags Will There Be?	Ratio and Proportions, Population Sampling	6.RP.3	6.RP.3c	7.RP.2	7.RP.3	7.SP.1	7.SP.2	
5	How Can We Make Stronger Passwords?	Permutations, Combinations, Probability, Exponents, Exponential Growth	7.SP.8	8.EE.1	S-MD.7	S-CP.5	S-CP.9		
6	How Many Hot Dogs And Buns Should He Buy?	Least Common Multiple (LCM)	6.NS.4						
7	What Does 2000 Calories Look Like?	Unit Rates, Ratios, Solving Equations, and Solving Inequalities	6.EE.3	6.EE.4	6.EE.5	6.EE.6	6.EE.7	6.EE.8	6.RP.2
8	How Much Money Are The Coins Worth?	Decimal Operations and Coin Counting	2.MD.8	5.NBT.7	6.NS.3				
9	How Many Times Will A Case of Paper Jam?	Interpreting Percentages	6.RP.3c	7.RP.3					
10	How Many Soda Combinations Are There On A Coke Freestyle?	Counting, Composing, and Decomposing Numbers	K.CC.5	K.CC.6	K.OA.1	K.OA.2	K.OA.3	K.OA.4	K.NB
11	What Should The Freeway Sign Show?	Fractions on Number Lines, Converting Units, Decimal and Fraction Operations	3.NF.1	3.NF.2	3.NF.2a	3.NF.2b	3.NF.3	3.NF.3a	4.MD.
12	How Fast Was The Fastest Motorcycle Speeding Ticket Ever?	Converting Units and Unit Rates	5.MD.1	6.RP.3d	7.RP.1	N.Q.1			
13	How Much Did Patrick Peterson Lose By Not Cashing His Check?	Compound and/or Simple Interest	7.RP.3	N-RN.2	A-SSE.1	A-SSE.3c	A-SSE.4	A-REI.11	F-IF.4
14	How Many Biscuits Can You Make?	Dividing Fractions and Mixed Numbers	5.NF.7	5.NF.7a	5.NF.7b	5.NF.7c	6.NS.1		
15	How Much Bigger Should They Make Zoolander's School?	Scale and Proportions	5.NF.5A	7.RP.2	7.G.1				
16	Where Is The Freeway Sign Located?	Identifying Fractions on a Number Line	3.NF.1	3.NF.2	3.NF.2a	3.NF.2b	3.NF.3	3.NF.3a	3.NF.3
17	How Far Apart Are Exits On A Ring Road?	Arc length measures	G-C.5						
18	How Much Is One Third Of A Cup Of Butter?	Identifying Fractions on a Number Line	3.NF.1	3.NF.2	3.NF.2a	3.NF.2b	3.NF.3	3.NF.3a	3.NF.3
19	How Do Skytypers Write Messages?	Transformations (Rotations, Reflections, Dilations, and Translations)	8.G.1	8.G.2	8.G.3	8.G.4	G-CO.2	G-CO.3	G-CO
20	How Big Is The Bermuda Triangle?	Coordinate Geometry: Area of Triangle	G-GPE.7						
21	What Fraction Of Children Are In The Right Car Seat?	Representing and Comparing Fractions	3.NF.1	3.NF.2	3.NF.3	4.NF.1	4.NF.2		
22	How Much Did The Temperature Drop?	Absolute Value	6.NS.7c	7.NS.1c					
23	How Much Shorter Are Staggered Pipe Stacks?	Circles, Pythagorean Theorem, trigonometric ratios, and linear functions	8.G.7	A-CED.1	A-CED.3	A-CED.4	A-SSE.1a	A-SSE.1b	A-SSE
24	How Do You Write A Check To Pay For Something?	Expanded Form	2.NBT.3	4.NBT.2	5.NBT.3a				
25	How Can We Correct The Scarecrow?	Pythagorean Theorem	8.G.6	G-SRT.4					
26	How Much Does A 100x100 In-N-Out Cheeseburger Cost?	Building and Interpretting Linear Functions	8.F.1	8.F.3	8.F.4	8.F.5	F-IF.4	F-IF.5	F-IF.6
27	How Can We Water All Of The Grass?	Circles, Pythagorean Theorem, trigonometric ratios	7.G.4	8.G.7	G-SRT.8	G-MG.1	G-MG.3		
28	How Much Money IS That?!	Volume of rectangular prism	5.MD.3	5.MD.4	5.MD.5	5.MD.5b	5.MD.5c	6.G.2	7.G.6
29	How Much Money Should Dr. Evil Demand?	Exponential Growth	N-RN.2	A-SSE.1	A-SSE.3c	A-SSE.4	A-REI.11	F-IF.4	F-IF.7
30	How Tall Is Mini-Me?	Scale and Dividing Decimals	5.NF.5	5.NF.5a	5.NF.5b	6.NS.3			
31	How Did They Make Ms. Pac-Man?	Transformations (Rotations, Reflections, and Translations)	8.G.1	8.G.2	8.G.3	8.G.4	G-SRT.2	G-CO.4	G-CO
32	Which Ticket Option Is The Best Deal?	Unit Rates and Ratios	6.RP.2	6.RP.3	6.RP.3a	6.RP.3b			
33	How Far Apart Are The Freeway Exits?	Fractions on a Number Line and Subtracting Fractions	3.NF.2	3.NF.2b	4.NF.2	4.NF.3a	4.NF.3c	4.NF.3d	5.NF.1
34	Do We Have Enough Paint?	Area	3.MD.5	3.MD.6	3.MD.7				

Sheet1

Scary & Dangerous

THE FOUR STEPS TO CREATE A CLASSROOM WHERE STUDENTS ARE EXCITED TO LEARN MATHEMATICS

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